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THE KENTUCKY RIVER BRIDGE.

In our SCIENTIFIC AMERICAN SUPPLEMENT, No. 66, we gave an account of this new and remarkable structure, and we now present further particulars and views, showing the method of construction, for which we are indebted to the *Railroad Gazette*.

The final closure of the two halves of the bridge took place on February 20, 1877, and the bridge was subjected to a series of tests of great severity on April 20, which closed its history as a problem in solution. To recapitulate this history somewhat: The Kentucky River, at the point where it is crossed by the Cincinnati Southern Railway, flows between two walls of limestone rock from 300 to 450 feet high—almost perfectly vertical, and varying from 1,000 to 1,300

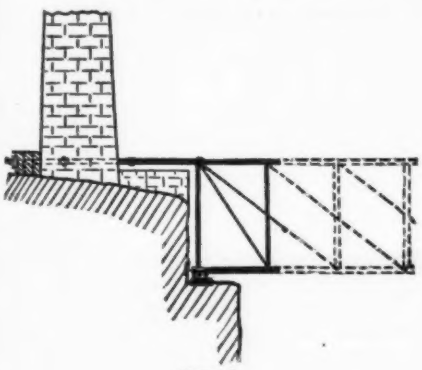


Fig. 1.

ft. apart. This canon is extremely tortuous, and the stream flowing through it is about 300 ft. in width at ordinary stages. The maximum rise above low water is 57 ft., and the extreme flood speed observed during the construction of the bridge was eight miles per hour. Steamboats run up to and above the bridge site, and the lumber traffic is quite heavy, rafts frequently passing the bridge at the rate of twenty per hour during the freshet season. As the river makes a sharp bend just under the bridge, a pier in the waterway was inadmissible, and the fact that on the north shore the bed rock was covered with a treacherous soil, full of springs, easily scoured, and 58 feet deep, made the question of foundations on that side a very serious one both as to cost and safety. To meet all these contingencies it was decided, first, that three spans of 375 ft. each were required in order to give sufficient raft room and to avoid the costly foundations necessary on the north side; next, that as the great height rendered falsework costly for the shore spans, and the frequency of floods made it impracticable for the river span, the plan of erection must be one that involved no staging in the waterway; lastly, that while a continuous girder in three spans would fulfill all of these conditions during erection, yet the fact that the iron piers would rise and fall from the effects of temperature, while the cliff abutments would not, made it obligatory that the spans should be so hinged as to permit of this vertical motion of the piers without varying the strains in the truss. A careful investigation as to the proper point at which to hinge the girder showed that economy was best attained by cutting the lower chord of the end spans at one fourth the span length from the pier. From these considerations grew the plan finally adopted, the following description of which we quote from our former article:

"The viaduct as now constructed consists of three spans of 375 feet each, resting on the bluffs and two iron piers, which latter in turn are supported by stone piers, each 120 feet long by 42 feet in width at the base. The iron piers consist of four legs each, and while having a base of 71 ft. 6 in. by 28 ft., their longitudinal profile terminates in a point at the top, or rather in a 12-inch pin upon which the truss rests, as on a rocker. The entire pier is a complete structure within itself and can be rolled about on the masonry, the pedestals resting on double roller beds for this purpose.

"The truss itself is, during erection, a continuous girder of the Whipple type; but after erection it will be converted into one continuous girder 525 ft. long, projecting at each end 75 ft. over its points of support and carrying from each of these cantilevers a 300 ft. span, which bridges the distance from the end of the cantilever to the bluff.

* * * * *

"The truss is 37·5 ft. deep and 18 ft. wide, and each bay is divided into 20 panels of 18·75 feet each. All connections between ties, posts and chords are hinged or pin connections, but the chords are riveted to each other throughout, with the novel addition that the pin carrying the tie bars is forced into the chord splice by hydraulic pressure, and thus does duty as a rivet. It will be seen that the details combine both the American principles of pin joints and of massing the materials in approved shapes along the lines of strain, together with the European practice of continuous riveted chords fitted to resist both tension and compression. This peculiar mode of construction was adopted in order to erect the truss in the manner which we are now about to describe.

After the bridge seat was cut out of the cliff, the end posts were set up and the first section of bottom chord laid in place, each chord being continued back to the rock by a large screw jack placed between its rear end and the face of the bluff. Then the top of each end post was bolted back to Roebling's towers by anchor bolts, which had a screw adjustment. From this point the end or main tie was carried to the bottom chord at the foot of the second post, and then post No. 1 and the first panel or top chord were put in place. When the panel was in position the work looked as shown in Fig. 1. It will readily be seen that, with these connections once made, the structure could be built out panel by panel until the limit of strength of the anchorage bolts or of the top chord of the available resistance of the Roebling towers had been reached. This last was the governing factor, and the other parts were proportioned to suit. Accordingly, as the truss grew out from the face of the bluff a temporary wooden tower sprang up from the bottom of the valley to meet it, the center of the tower being 196 ft. 10 in. from the shore end of the span. When the truss was landed on the tower, the four truss posts resting on it were raised by large jack-screws until the anchor bolts were relieved of a previously determined portion of their strain, and when this point was reached the work of carrying out the span was again commenced.

"The next flight was to the permanent pier, 178 ft. 2 in.

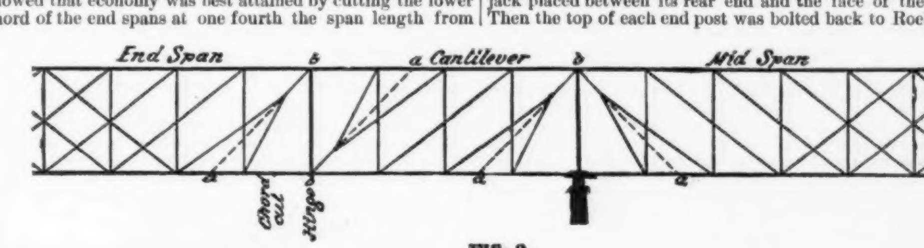
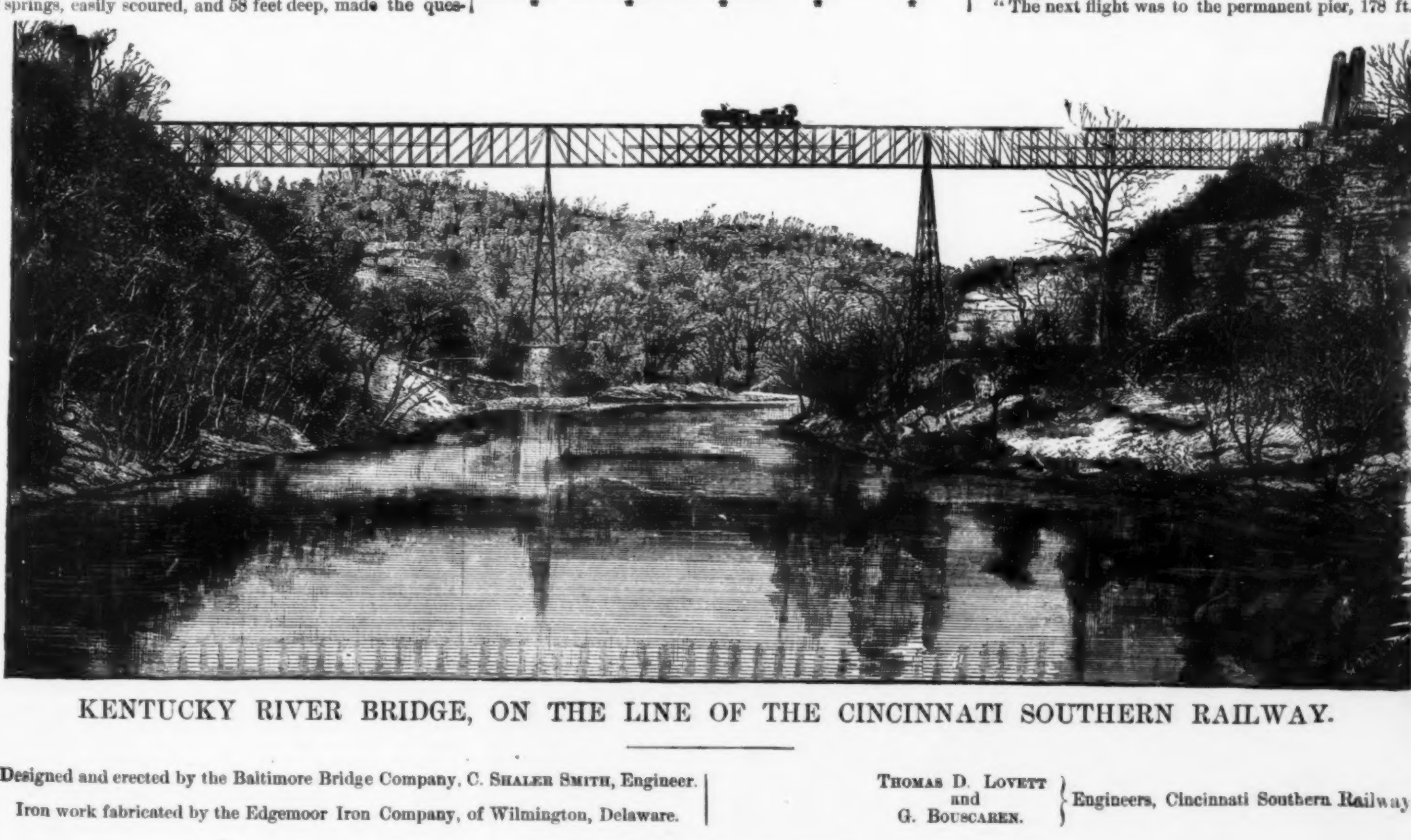


FIG. 2.



KENTUCKY RIVER BRIDGE, ON THE LINE OF THE CINCINNATI SOUTHERN RAILWAY.

Designed and erected by the Baltimore Bridge Company, C. SHALER SMITH, Engineer.

Iron work fabricated by the Edgemoor Iron Company, of Wilmington, Delaware.

THOMAS D. LOVETT and G. BOUSCAREN, Engineers, Cincinnati Southern Railway.

DIMENSIONS AND QUANTITIES:

Length between abutments	1138.00 feet.	Height of rail above pier base	287.10 feet.	Iron in spans	2,855,379 lbs.
Length of each span	375.00 "	Total height of iron work	214.75 "	Iron in piers	798,901 "
Depth of truss	37.50 "	Total height of masonry	71.25 "	Cubic yards of masonry	12,935
Width of truss	18.00 "	Stone pier at base	120x42.0 "	Cubic yards of foundation excavation	14,065
Height of rail above low water	275.50 "	Iron pier at base	71.5x28.0 "	Flood rise of river	57 feet.
Height of rail above river bed	279.50 "	Iron pier at top	18.0 x 1.0 "		

ERECTION OF THE KENTUCKY RIVER BRIDGE. HALF OF NORTHERN SPAN JUST BEFORE REACHING TEMPORARY WOODEN PIER.

When the span left the bluff, the iron pier was started upward from the masonry, and the two met in mid-air, the working forces on each arriving at the point of junction within two hours of each other. The weather was cold, and the span was short, owing to the compression of the lower chord and the effect of temperature; but this had been foreseen, and the huge pier, weighing 40,000 lbs., was moved on its rollers toward the span until the pin which connects the two could be put in place. This done, the truss was built out as before until the middle of the river was reached, which completed the work from the north side. * * * * *
In erecting this bridge the most important points for computation were: first, the angle to be given the span at starting so as to land properly on the wooden pier; and, next, the correct elevation to be given to the truss at the wooden tower so that an exact junction could be made with the pin on the top of the permanent iron pier. These operations were both successful."

The erection was carried on with little or no interruption during an exceedingly severe winter, the men working at times when the span and pier were covered with sleet and ice. The iron piers were raised without staging of any kind. After the completion of the masonry the derrick masts used on that part of the work were turned "end for end," and one stick placed at each corner of the pier as a gin pole. The necessary tackle was placed at the head of each pole and the fall line carried to a crab on shore, so that the men at ".e crab being out of danger from falling bodies would be inclined to act with more coolness in case of breakage. Each pole had an independent tackle for the purpose of giving it vertical motion, and as fast as each tier was raised the poles were moved upwards to the proper position for the next tier. These poles are seen in position in view No. 2 of the accompanying plates.

The machinery devised for raising both span and pier worked so perfectly that no drawback was encountered until the junction of the two halves of the bridge. At this stage of the work, the upper chords being almost entirely in tnesion and the lower chords in compression, the former were nearer to each other than the latter, and when the last sections were put in place the gaps were as follows:

Upper chord east,	gap of	"3	inches.
" " west,	"	2	"
Lower chord east,	"	"4	"
" " west,	"	5	"

The first operation was to close the gap of two inches in the west upper chord, which was readily effected by the use of the screw jacks at the shore ends of the bridge and by moving the piers towards each other. This left a gap of 13 in. between the ends of the east top chord. At midday, therefore, with the thermometer standing at 70° in the sun, all the horizontal laterals tending to draw these ends together were screwed up taut and the counter-laterals were slackened. The contraction of the lateral rods closed the gaps at daybreak on the following morning—temperature at 40°. The top chord connections were now riveted up, leaving the gaps in the lower chords respectively one and two inches. The contraction due to temperature had by 4 o'clock next morning withdrawn the shore ends of the lower chords three quarters of an inch from the jacks. These were screwed out so as to take up this space, and by midday the chord had expanded until the gap in the east chord was closed and the connection was made. This operation was repeated for the west chord, and in twenty-four hours later the junction was made and the girder completed from shore to shore.

The final operation consisted in cutting the lower chord at the previously selected points in the shore spans so as to hinge the girder. Tenon joints had been made in the lower chord at these points, in which temporary rivets had been driven. These were now driven out one by one until the connection was severed and the end spans hung free. The mean motion of the severed joint after cutting was only $\frac{5}{16}$ of an inch, and the change in the profile of the bridge was barely perceptible. This proved the accuracy of the method for determining the proper point for cutting In this the theory of the elastic line was ignored entirely, and the truss was dealt with panel by panel, and member by member, chords, posts and ties, until the point of contraflexure was reached.

For the information of those gentlemen who in these columns and in the pages of *Van Nostrand's* have so vigorously discussed the properties of continuous girders and the modulus of elasticity, we will here state that in this bridge the greatest efforts were made to secure a uniform modulus. Iron mix ures were prescribed in the puddling furnace and in the rolling mill pile. Every plate was tested at the mill and all bars paired together by their moduli while the workmanship was very exact. Despite all this, the moduli varied from 20,400,000 to 28,200,000 lbs., and during erection, the two trusses began to vary in height at three panels from the starting point, which variation exceeded one inch at several places. As has just been stated, the variation in length, arising mostly from this cause, between the east and west chords amounted to one inch in 1,125 ft.

The erection was commenced on the 16th of October, 1876, and completed Feb. 20, 1877, four months and four days. At no time did the force exceed 60 men, and the average number was about 53 on duty.

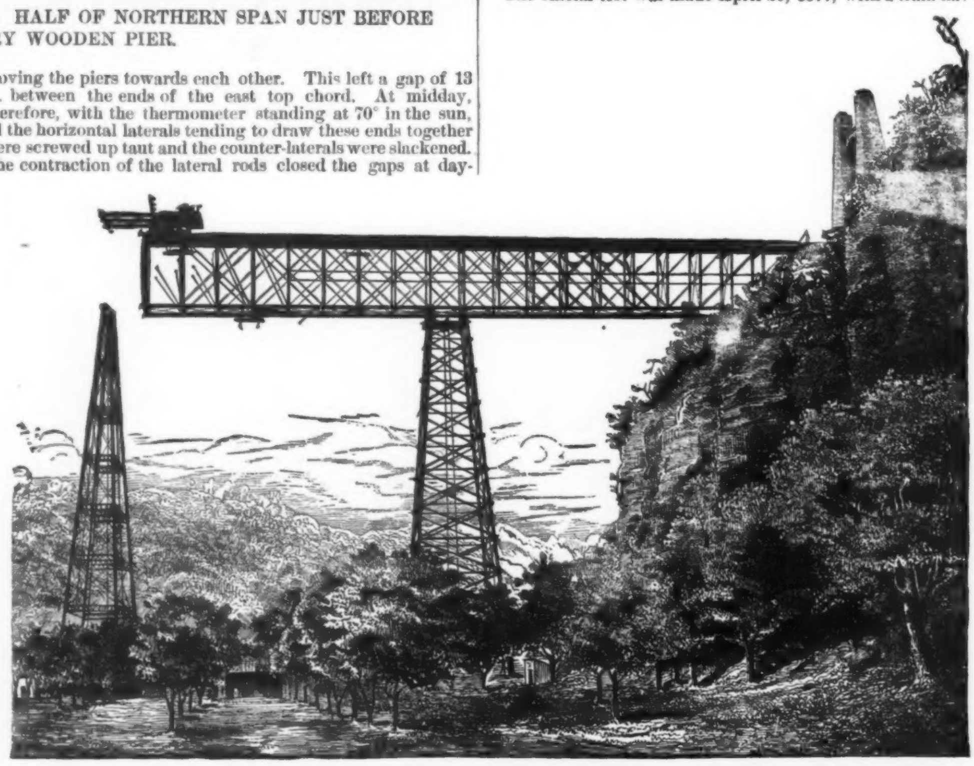
The official test was made April 20, 1877, with a train having four engines in the middle and iron cars at either end loaded to 40,000 lbs. each. The equivalent uniform load was 2,073 lbs. per foot on the 300 ft. spans, and 1,977 lbs. per foot on the 375 ft. spans. The deflections were as follows:

Both end spans loaded.	*Inches.*
Greatest deflection of 300 ft. span	1·518
" " " cantilever point	1·944
" depression of pier	0·372
Upward deflection of mid span	"2·832
Mid span loaded—Ends unloaded.	
Greatest deflection of mid span	"3·498
Upward motion at cantilever point	"1·580

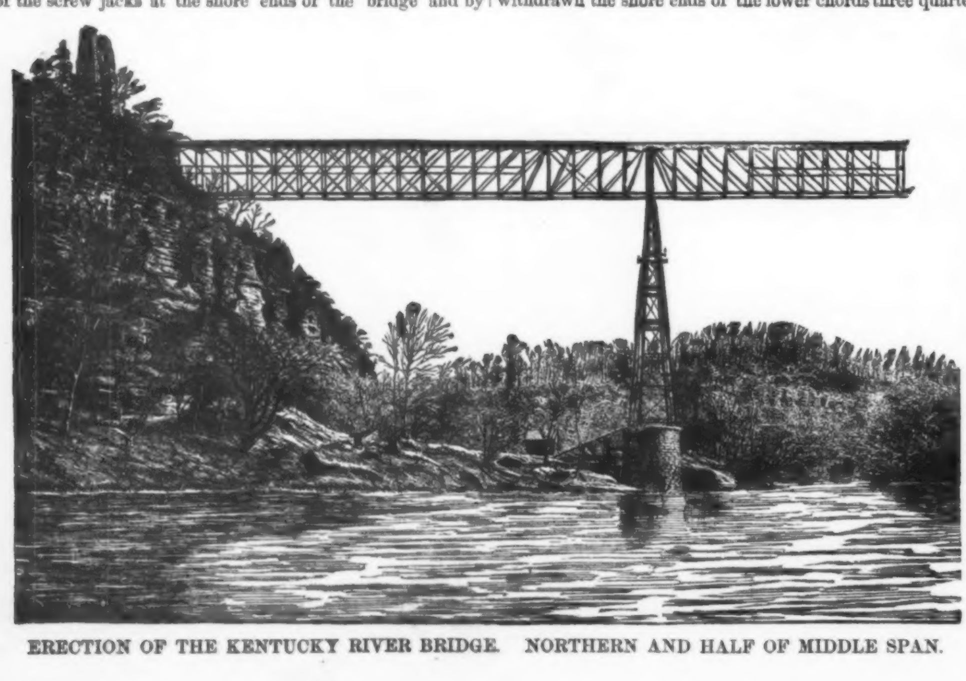
As the longitudinal stability of the truss is derived from the piers, the last trial was for the purpose of testing this stability. An engine drawing 24 cars, loaded with railroad iron, was moved on the bridge at a speed of 26 miles per hour. There was a brakeman on each car, and at a given signal the engine was reversed and the brakes applied, the train being brought to rest in 104 feet. The extreme motion of the pier heads caused by this test was only one half inch.

One of the peculiarities of this structure is that the piers and span are pinned together, no provision whatever being made for expansion and contraction. In proportioning the piers, however, they were considered to be vertical only at 60° temperature. At 150° each pier will be bent outwards, and when in this condition it was assumed that a train weighing 1,125 tons would come to rest on it from a high speed, with the brakes all down and the wheels sliding. The extra strains from temperature and moving train having been determined, the necessary sections to meet them were added to the normal sections of the pier. One other fact revealed by the test is too significant to be passed without notice. To avoid ambiguity in the strains at the hinging points, both of the web systems are consolidated into one member at the point of the contraflexure and separated again after the hinge is passed. See Fig. 2.

During the trials it was found that the longitudinal motion of the tenon where the lower chord was cut was 1¼ inch. This is suggestive when applied to the consideration of the



ERECTION OF THE KENTUCKY RIVER BRIDGE. NORTHERN SPAN JUST BEFORE REACHING PERMANENT IRON PIER.



ERECTION OF THE KENTUCKY RIVER BRIDGE. NORTHERN AND HALF OF MIDDLE SPAN.

character of the strains in the web system of a continuous girder at the point of contraflexure.

The enormous proportions of this great viaduct can best be appreciated from the following table of dimensions and quantities:

Lengths between abutments	1,138·00 ft.
" of each span	375·00 "
Depth of truss	37·50 "
Width "	18·00 "
Height of rail above low water	275·50 "
" " " river bed	279·50 "
" " " pier base	286·16 "
Total height of iron work	214·75 "
" " " masonry	71 25 "
Stone pier at base	120×42 "
Iron " "	71·5×28 "
Iron " top	18·0×1·0 "
Iron in spans	2,855,379 lbs.
" in piers	798,901 "
Cubic yards of masonry	12,635 "
" " of foundation excavation	14,665 "
Flood rise of river	57 ft.

The iron work of this bridge was manufactured by the Edgemoor Iron Company, of Wilmington, Del., and is said by those who have had abundant opportunity to know to be superior to that of any other iron bridge in the country. The parts, it is said, went together like a Springfield musket.

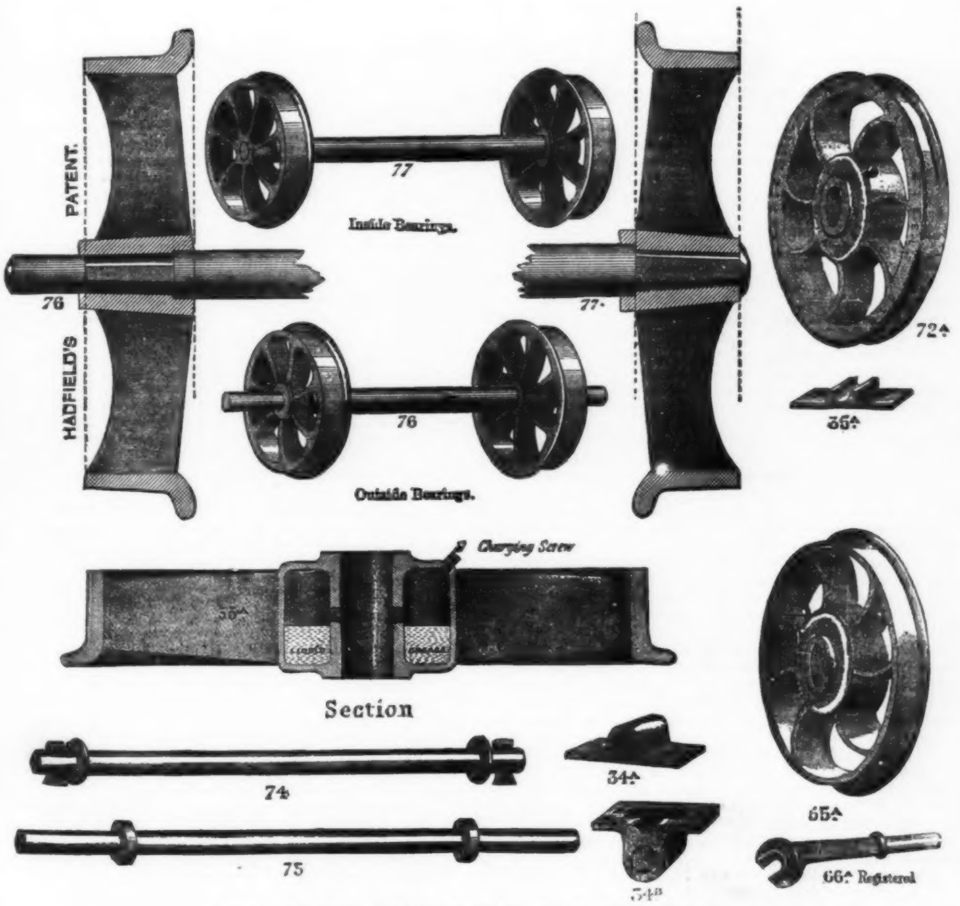
The whole work was carried out very successfully, and reflects great credit upon the engineer, Mr. C. Shaler Smith, who designed the work, and the Baltimore Bridge Company, which executed it.

IMPROVED WHEELS FOR COLLIERY CORVES.

THE importance of attending to comparatively insignificant details in connection with colliery operations in order to secure the maximum of economy has been pointed out at several meetings of the Iron and Steel Institute, and it has there been shown that even in the oiling of the wheels an important economy can be effected. The method of securely fitting corve or tram wheels is another detail which has received much attention, yet very few of the arrangements proposed have been altogether satisfactory; the speed at which the wagons travel, the severe shocks they continually meet with, and the frequent spragging the wheels have to undergo, severely test not only the strength and quality of the wheels and axles but also the methods by which they are fastened together—hence at numerous collieries many wheels are constantly working loose and causing much annoyance, as well as extra wear and tear, trouble, and expense. The crucible steel castings turned out during the past quarter of a century from the works of the Hadfield Steel Foundry Company, at Sheffield, have secured for them a reputation wherever such castings are used, and it appears that at present more than one-half of the works are employed in manufacturing crucible steel wheels for mining corves, the number of wheels produced exceeding, it is said, that of all the rest of the trade put together, as can readily be understood when it is remembered that the number made reaches 2,000 per week.

Among the many recommendations of the Hadfield Company's wheels may be mentioned that they are cast from one-third to one-half lighter than cast iron, yet they cannot be broken while working, even with the roughest usage. The experience at collieries in all parts of the kingdom proves that these wheels will outlast at least twelve iron ones, which, added to the saving effected in animal and steam power, becomes a very important item of economy in connection with the working expenses. With regard to the reduction of wear and tear much may be attributed more especially to the application of Mr. Hadfield's patented method of fitting wheels upon axles, illustrated in the above diagrams, in which No. 77 shows wheels fitted for inside bearings. The axle hole in the boss of these wheels is cast by special appliances round for a short distance, whilst the remaining and greater portion is slightly tapered square. The axles are forged from the plain round bar to a corresponding shape at each end, and the wheels are then pressed upon these square-ended axles by powerful machinery, and afterwards slightly riveted; the full strength of the axle thus entering the boss of each wheel—a matter of great importance—the machine which presses on the wheels securing truth and exactness in gauge. No. 76 shows wheels fitted for outside bearings, a mode which in principle is similar to inside bearings, only that the axle hole is cast in octagonal form, and the axle is forged to suit, but projects through instead of being riveted up. In the case of a wheel or axle wearing out, bending, or breaking, either can be readily unfitted or replaced. Recently, to satisfy one of the largest colliery companies on this point, it is stated that the same wheel and axle were taken apart, and refitted no less than five times, without impairing the strength of the axle to any appreciable extent. By this very simple and highly effective method we are informed that all wedges, iron hoops, keys, boring, turning, slotting bolts and nuts, washers, and similar unreliable appliances, are dispensed with, and a lighter and much stronger wheel and axle, and a far more reliable, neater, and cheaper fastening, is obtained than can be secured by any other method, the wheel and axle being practically so secure that they may be considered as one. As is well known, there are many systems for fitting mining wheels upon axles, but only a few have come into practical use; others will never do so, being too complicated, costly, and unreliable. Something simple and effectual is required, and nothing else should be adopted in mining operations.

The extent to which the economy of these wheels has been appreciated will be judged of from the circumstance that although this method of fitting is comparatively new, it is already adopted in hundreds of mines and collieries; upwards of half a million wheels and axles in daily use in Great Britain, on the Continent, and elsewhere being fitted entirely by their patent fast method, a better guarantee of superiority could scarcely be desired. This result is, perhaps, less surprising when considered in connection with the fact that Messrs. Hadfield have had many years' experience in connection with this particular class of work, and that it is this very experience which has enabled them to perfect the design. And it is not inaptly remarked that, as if to doubly prove the advantages of this method of fitting, some firms have recently infringed the patent, and had to be stopped by injunctions, which, however, were very readily obtained.



IMPROVED COLLIERY CAR WHEELS.

Valuable in connection with the same subject are Messrs. Hadfield's self-oiling wheels, represented by those of the above diagrams numbered 75 and under. The inventors claim that these possess certain advantages possessed by no other wheels, being specially adapted for collieries, ironstone mines, slate quarries, lead and copper mines, etc., where loose wheels (wheels revolving upon their own axles) are used. The old system of lubricating loose wheels is known to be attended with labor and waste, and so little of the grease or oil applied reaches the wearing surfaces, and as regreasing can only take place at fixed parts of the workings, the bosses of the wheels and bearings of the axles soon become dry, and cut each other, thus causing considerable wear and tear, and necessitating extra labor, haulage power, and expense. These defects, it is stated, are remedied by these wheels, the advantages claimed for which are very numerous. Two-thirds, at least, less grease or oil is required than at present used by any known method of lubricating mining wagons, whether by hand, machine or otherwise; and they effect a very great saving in haulage power, also in wear and tear, being so constructed as never to allow the bearings to become dry. The revolving of the wheel leads out the oil as required, and immediately the wagon stops the lubricator ceases its action. No waste of grease can occur, no matter in what position the wagon may be placed when discharging its contents (even if upside down), and when the wagons are not in use it is utterly impossible for any grease to escape, as it is all stored below the outlet. When once these wheels have been charged with liquid grease (which can be done by any experienced person) they do not require any attention or re-greasing whatever for several weeks, or even months, afterwards, in proportion to the distance travelled. These wheels can be readily fixed to any description of wood or iron corves now in use, whether the wheels are upon the inside or outside of the frame; they are exceedingly simple in construction, have no detail, are not liable to get out of order, and possess great strength, durability, and extreme lightness, being made of crucible steel.—*Mining Journal.*

ON THE EFFECT OF PUNCHING ON IRON AND STEEL PLATES.*

By MR. A. C. KIRK, Associate, I. N. A.

FROM the extensive use of riveting as a means of joining together plates of both iron and steel, it seemed to me that the following experiments, though they do not by any means exhaust the subject, are worth placing before the meeting. These experiments were made by me for Messrs. John Elder & Co., and had their origin in that firm having to construct boilers for two Channel steamers in which, in order to save weight, the shells were made of steel. For several reasons it was decided to make them in the usual way, punching the holes, heating the plates if necessary for bending and drilling the holes out fair before riveting; but the diversity of opinion as to the effect of punching was so great that information could only be got by experiment. For instance, Mr. Cochrane's experiments in vol. xxx. of the "Transactions of the Civil Engineers," page 265, showed that in a case of variety of irons, the strength was the same whether holes were drilled, punched first and cleaned out by a drill, or simply punched. On the other hand, the Board of Trade, in their instructions to surveyors, increase the factor of safety or thickness of plates forming the cylindrical shell of a boiler by 5 per cent., if the holes are punched instead of drilled. Unfortunately, as we do not know on what this opinion is based, whether on experiments or not, or if on experiments, what the nature of these was, we do not know what weight to attach to it. The necessity of drilling has been even more insisted on when steel is used, this metal having been held by many to be unfitted for punching. On the other hand, Mr. J. J. Smith, in vol. xlii. of the "Transactions of the Civil Engineers," page 76, says: "Experiments have demonstrated that the zone of metal injured by punching steel having a tensile of strength of not more than 32 tons, is not more than 1/8 of an inch in breadth, and that if the fish-plate holes (he is speaking of steel rails) are first made with a small punch and then enlarged by drilling to the required size, the steel is not more injured than if the hole had been drilled only." The Admiralty, in the steel they use for shipbuilding, and its strength is under 32 tons, have the holes punched. The object of the following experiments was, if possible, to reconcile this diversity of opinion and trace to what causes it might be due. The pieces for testing, whether riveted together, or simply perforated, were in all cases perforated in a broad piece of plate as they would be in practice, and afterwards cut by a slotting machine into strips with holes in the center of each piece, or, in some cases, through the center of two contiguous holes. In those intended to represent a specimen of boiler riveting, the holes were made in the plate at the pitch intended plus the breadth of the parting tool, so that the test piece should represent a rivet pitch. The larger experiments in Tables A, B, and C, were made by the Testing Company here, and the smaller in the following Tables were made by a machine in Messrs. Elder's works. In both, the strain is measured by a steelyard. The tests in Table A were made on specimens cut lengthways out of a piece of ordinary iron plate, and show clearly that the clearance of the punch in the bolster affects the strength of the punched plate. There is little doubt but that had a 1¼ bolster been tried the original strength of the plate would have been very nearly maintained. Mr. Cochrane probably used a wide bolster, and this, combined with the fact that the holes he punched were punched in bar iron, may account for the results he got. When a comparatively narrow bar is punched, much of the compression of the metal round the hole is relieved by the metal bulging and stretching so that the bar becomes increased in breadth at the hole and slightly elongated.

TABLE A.—TESTS OF MALLEABLE IRON PLATE.

Breadth in inches.	Thickness in inches.	Diameter (mean) of hole.	Hole, how made.	Diameter of punch.	Diameter of bolster.	Breaking stress in tons per square inch.	Ratio of breaking strain to mean strength of plates.
				Inch.	Inch.		
5·260	1·170	1·370	Drilled	—	—	18·58	1 : 1
5·250	1·150	1·180	Punched	1⅛	1¼	15·27	1 : ·82
5·260	1·160	1·180	"	Ditto	Ditto	15·75	1 : ·85
5·240	1·170	1·220	"	"	1⅜	16·81	1 : ·90
5·260	1·160	1·220	"	"	Ditto	17·08	1 : ·92

In Table B are given a similar set of experiments on steel plates, and in these the beneficial effect of using a large clearance in the bolster is well marked.

TABLE B.—TESTS OF STEEL PLATE.

	Brdth. in inches.	Thickness in inches.	Diameter (mean) of hole.	Hole, how made.	Diameter of punch.	Diameter of bolster.	Breaking stress in tons per square inch.	Ratio of breaking strain to mean strength of plate.
					Inch.	Inch.		
A	3·990	0·740	1	Drilled	—	—	27·12 } 27·11	
B	3·990	0·740	1	"	—	—	27·10 }	1
C	3·990	0·750	1·020	Punched	1 and ⅞	1 1-16 & 15-16	17·96	1 : ·66
D	3·990	0·750	1·020	"	—	—	18·18	1 : ·67
E	3·990	0·745	1·050	"	⅞ and 13-16	1 1-16 & 15-16	23·21	1 : ·85
F	3·990	0·750	1·050	"	—	—	20·40	1 : ·75

Table C contains experiments on actual riveted joints, substantially the same as those adopted for the boilers above referred to. In the boilers, for convenience, instead of using larger rivets in the two middle rows, the number of rivets is increased and the pitch diminished so that the same section of rivet is got as in the specimens tested. These pieces were all heated to a low red heat, and the holes cleaned out by a drill before riveting. The result is that the full strength of the plate is maintained. It will be seen afterwards that much of this was due to the plate having been heated after punching.

TABLE C.—TESTS OF STEEL PLATE.

	Brdth. in inches.	Thickness in inches.	Diameter (mean) of hole.	Hole, how made.	Breaking stress in tons per square inch.	Section of plate to rivet.	
A	4·000	0·65	—	—	28·62 }	—	
B	3·99	0·660	—	—	28·06 }	—	
C	3·760	0·660	·9375	{ Punched and drilled. }	29·68	1 : 1·60	
D	3·760	0·660	·9375	"	28·48	1 : 1·60	
E	3·60	0·660	·9375	"	28·48	1 : 1·79	Rivets slightly in excess of plate.
F	3·61	0·650	·9375	"	28·78	1 : 1·81	Plate broke through first rivet hole.

* Read at the Eighteenth Session of the Institution of Naval Architects, at Glasgow, 29th August, 1877. Lord Hampton in the chair.

A and B, two samples taken to ascertain strength of plates. C, D, E, and F, these consisted of two pieces riveted by iron rivets. The holes were punched, paired by drill and heated, as would be done preparatory to bending the shell plates of a boiler.

Table D contains a set of experiments on steel plate ¼ in. thick and perforated by ¾ holes, made in Messrs. Elder's testing machine. Table E contains a similar set made on portions of the same plate as that from which the specimens in Table D were cut. A comparison of these shows that where the diameter of the hole is as much as three times the thickness of the plate, the plate may be punched with impunity, and that annealing produces little or no benefit.

TABLE D.—TESTS OF STEEL PLATE AS RECEIVED FROM MAKER.

Description of test.	Breadth.	Thickness.	Area.	Strain of section in tons.	Strain per square inch in tons.	Elongation in one inch.
						Inch.
	1·51	·27	·407	12·1	29·7	
	1·49	·27	·403	12·0	29·77	
Punched	1·525	·28	·427	12·6	29·5	3-16
Punched	1·57	·28	·439	12·6	28·7	3-16
Punched and drilled	1·45	·27	·391	11·05	28·2	5-16
Punched and drilled	1·46	·27	·394	10·90	27·6	5-16
Drilled	1·5	·27	·405	12·0	29·6	5-16
Drilled	1·47	·27	·397	11·7	29·4	5-16
Punched at each side ..	1·515	·28	·424	12·05	28·4	3-16
Punched at each side ..	1·445	·28	·404	12·0	29·7	3-16
Punched and drilled at each side	1·445	·28	·407	12·0	29·4	3-16
Punched and drilled at each side	1·485	·28	·415	12·75	30·7	3 16

The above specimens were cut lengthways from the plate.

TABLE E.—TEST OF PART OF SAME STEEL PLATE ANNEALED IN DRY LIME AFTER BEING PREPARED FOR TESTING.

Description of Test.	Breadth.	Thickness.	Area.	Strain of section in tons.	Strain per square inch in tons.	Elongation in one inch.
						Inch.
	1·51	·275	·415	12·2	29·3	
	1·51	·275	·415	12·2	29·3	
Punched and drilled	1·52	·27	·41	12·55	30·6	5-16
Punched and drilled	1·54	·27	·415	12·15	29·2	5-16
Drilled	1·51	·28	·428	12·0	28·4	5-16
Drilled	1·51	·28	·425	12·05	28·5	5-16
Punched and drilled at each side	1·51	·275	·413	12·3	29·6	5-16
Punched and drilled at each side	1·51	·275	·415	12·15	29·2	5-16
Drilled at each side	1·5	·27	·405	12·0	29·6	5-16
Drilled at each side	1·515	·27	·408	12·0	29·4	5-16

The above specimens were cut lengthways from the plate.

On comparing these with the experiments in Table F, in which the diameter of the hole is 2·4 times the thickness of the plate, it will be seen that the punched piece is reduced in strength almost 15 per cent. compared with that of a similar piece subsequently heated. Unfortunately the pieces of steel were in this case exceptionally hard.

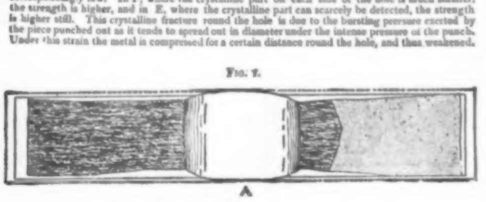
TABLE F.—TESTS OF STEEL PLATES.

Mark of Test.	With or across Grain.	Description of Test.	Breadth.	Thickness.	Area.	Strain of Section in Tons.	Strain per square inch in Tons.	Elongation in Inches.
A H	With	Punched at each side.	1·85	·425	·503	18·2	36·18	9-32
B H	„	Punched at each side.	1·2	·425	·51	17·4	34·11	5-16
C	„	Punched at each side.	1·2	·425	·51	16·2	31·76	3-32
D	„	Punched at each side.	1·2	·425	·51	15·2	29·8	3-32

NOTE.—Those marked H after being punched were heated and allowed to cool.

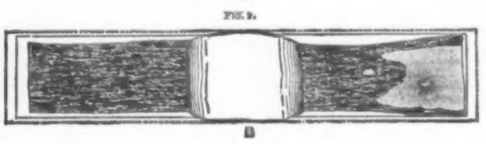
Figs. 1, 2, 3, 4, 5, 6 show the fracture of the specimens in Table B. The effect of the punch is clearly shown in the fracture by a portion highly crystalline on each side of the hole. In D, which was punched by a large punch, this is large, and the strength of the specimen is correspondingly low. In F, where the crystalline part on each side of the hole is much smaller, the strength is higher, and in E, where the crystalline part can scarcely be detected, the strength is higher still. This crystalline fracture round the hole is due to the bursting pressure exerted by the piece punched out as it tends to spread out in diameter under the intense pressure of the punch. Under this strain the metal is compressed for a certain distance round the hole, and thus weakened.

FIG. 1.



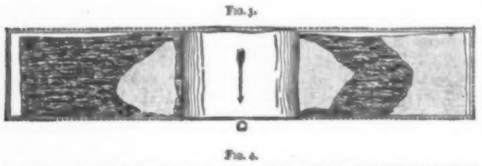
A

FIG. 2.



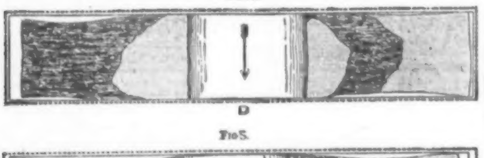
B

FIG. 3.



C

FIG. 4.

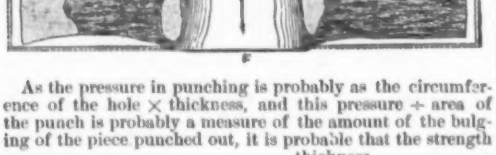


D

FIG. 5.

E

FIG. 6.



F

As the pressure in punching is probably as the circumference of the hole × thickness, and this pressure ÷ area of the punch is probably a measure of the amount of the bulging of the piece punched out, it is probable that the strength of the punched plate will be as $\frac{\text{thickness}}{\text{diameter of hole}}$; and a material with a high tensile strength and a low compressive strength will suffer more than one in which these conditions are reversed. The effect of compression was strikingly shown in some of the experiments. All of these split with a crystalline fracture at A B, though the section there was slightly in excess of that at C D. The pin was a little less in diameter than the hole, and the upsetting of the plate at B was distinctly visible, while the scale splintered off the steel for about 1½ in. in front of the hole, as shown by the dotted lines. We may infer from this that it is necessary to be careful that the compressive strains on the inside of rivet holes are not too great. Unfortunately I cannot assign a maximum limit for this; but in some earlier experiments on steel lap joints, with three rows of rivets, in which the rivets were sheared, distinct evidence was visible that the insides of the holes were slightly upset. This partly deterred me from attempting to get the large shearing area of rivet required, by putting the rivets in double shear, and caused me also to prefer four rows of smaller rivets to three rows of larger. The lap-joint also racks and leaks some time before it gives way, sufficient often to give some warning. In conclusion I would remark that experiments on punching are of little value unless the conditions under which the punching is done are known; that it is essential to use a bolster as wide as possible, and to heat the plates to a red-heat after punching, if of steel (and also of iron, though the neglect of it in this case is not so serious), in order that the strength of the punched plate may be equal to that of a drilled one, if the holes are less in diameter than three times the thickness of the plate.

HARDENING AND TEMPERING STEEL.

By JOSHUA ROSE.

No practical subject possesses more interest to the mechanic than that of hardening and tempering of steel. And for this reason that the steel of which all cutting tools are made depends more for its real value, upon the degree of its temper than the quality of the steel itself. A piece of untempered steel, even the finest grade, will under ordinary conditions not cut at all, while a piece of steel of inferior quality may be made to cut well if judiciously hardened and tempered.

While the capacity of steel to cut is mainly due to the temper, the durability of the cutting edge is determined by the quality of the steel and its adaptability to the kind of work upon which it is employed. Hence, it is that, for cutting tools, the best of cast steel is employed. The degree of temper is varied to accommodate the nature of the duty. The cost of steel of which a tool is made is of very little importance compared to its efficiency, because this cost is very little in comparison with that of performing the duty. For example, a steel turning tool weighing but two or three pounds will cut off many thousand pounds of iron, the operation lasting perhaps several weeks. The speed at which this tool will cut, or in other words, the time it will take to cut off a given amount of iron, will vary thirty or forty per cent. from a very slight difference in the quality of the steel of which the tool is made. The cost of the operator's time is so much greater than that of the steel used up in a given time, as to render it, even in the case of cheap labor, always economical to employ the best of steel. With a given quality, however, the efficiency depends more upon the skill employed in the forging, hardening and tempering of the tool, as well as upon its shape. To the skillful performance of these operations we must look for the difference in the quantity of work performed by different workmen, even when using the same grade of steel for similar duty.

The art of hardening and tempering steel as applied to cutting tools is much more simple than when the same operations are resorted to, to give steel elasticity as well as durability of form, or to give durability to pieces of slight and irregular form sufficient hardness to withstand abrasion. The reason of this is that for tool purposes a special and uniform grade of steel is readily obtainable, which is known as tool steel. Special sizes and grades are made to suit the manufacture of any of the ordinary forms of tools. The steel purchased under the cognomen of steel, whether crucible or otherwise, and though of the same make and brand, may vary so much as to seriously affect the degree of hardness or temper obtained by any specific process. Most of the difficulties met with are in obtaining a uniform degree of temper or in tempering without loss from water cracks, checks, etc. These defects may arise from rigidly adhering to some special process of hardening recommended by others, and can be overcome by varying the method to suit the quality of the steel. Very few, especially of American steels, are as yet sufficiently uniform to render it practicable to employ an unchangeable method of tempering, and to this fact is largely due the importation of particular brands of foreign made steel. Manufacturers of special tools, such as saws for example find that they must either manufacture their own steel or else import some well known brand, and this in the case of most articles manufactured that require a fine and uniform degree of temper. This is not so much due to the good quality of the article, as to a precise knowledge of the process necessary to temper such steel. We have as yet no known method of practically ascertaining in the workshops the quality of a piece of steel unless it be by use. As a rule, the steel that shows a fracture of fine dull grain, the face of the fracture being comparatively level, is of better quality than that showing a coarse or granulated surface. Brightness denoting hardness, and fibrousness a toughness.

The soft steels approaching more or less in their nature to wrought iron are exceedingly difficult to harden and temper to a uniform degree, because of the difficulty experienced in producing them of uniform grade. Many kinds of these steels are made of so low a grade as to make it difficult to determine the line of demarkation separating them from wrought iron.

Considerable discussion has of late, taken place as to what shall constitute the difference between wrought iron and steel. Mr. A. L. Holley said, in 1875; "Steel is a compound of iron, which is cast, while in a fluid state, into a malleable mass."

"I term steel," says M. A. Grüner, "whether molten or not, any kind of iron which will harden by tempering, but malleable when hot or cold, if it has not been cooled rapidly. I call soft iron, whether molten or not, any kind of iron which will not harden by tempering, and is malleable when hot or cold."

To this Mr. Holley objects and says: "If hardening in water is the characteristic of steel, who is to define hardening? As a matter of fact, all products of the crucible open hearth, Bessemer vessel and puddling furnace, containing 0·25 per cent. or more of carbon, will perfectly harden in water just in proportion to the carbon contained. If the product will make a tool, it is 'steel,' says the smith. What kind of a tool? Is an agricultural tool iron, and a cold chisel steel, or does steel begin between cold chisels and razors? If so, where? A water-hardened tool, perfectly adapted to certain uses, may be made of Bessemer metal containing half per cent. of carbon; the same ingot may make a good rail. If one part of the ingot is steel, why is the other part iron? The line between steel and iron must be sharply defined. Does it lie between 0·75 and 0·76 per cent. of carbon, or 0·99 and 1 per cent.? Obviously, no two men will, or can, agree on the amount of hardening or carbon which constitutes steel, so that the whole range of structural steels, forming at least three-quarters of all the steels produced, could not be included in any classification."

Dr. Percy, in his "Metallurgy of Iron and Steel," defines steel as iron containing a small percentage of carbon, the alloy having the property of taking a temper, and this definition is substantially equivalent to those found in the works of Karsten, Wedding, Grüner, and Tunner; on the other hand, Messrs. Jordon, Grüner, Gautier, Phillipart, Holley, and others, define as steel all alloys of iron which have been cast in malleable masses, whilst Sir Joseph Whitworth considers that steel should be defined mechanically by a coefficient representing the sum of its strength and ductility.

With the object of having universally adopted names which should indicate the nature and the distinction between iron and steels, an International Committee was appointed at Philadelphia by the Institute of American Mining Engineers. The committee consisted of the following gentlemen: Mr. I. Lowthian Bell, M. P.; Dr. Hermann Wedding; Professor Tunner; Professor Ackermann; M. Grüner, and Messrs. A. L. Holley and T. Egleston, and they resolved that the following should be recommended:

1. That all malleable compounds of iron, with its ordinary ingredients, which are aggregated from pasty masses, or from piles, or from any form of iron not in a fluid state, and which will not sensibly harden and temper, and which generally resemble what is called wrought iron, shall be called weld iron (German *Schweisseisen;* French *fer soudé*). 2. That such compounds when they will from any cause harden and temper, and which resemble what is now called "puddled steel," shall be called weld steel (German, *Schweiss-stahl;* French, *acier soudé*). 3. That all compounds of iron, with its ordinary ingredients, which have been cast from a fluid state into malleable masses, and which will not sensibly harden by being quenched in water while at a red heat, shall be called ingot iron (German, *Flusseisen;* French, *fer fondu*). 4. That all such compounds, when they shall from any cause so harden, shall be called ingot steel (German, *Fluss stahl;* French, *acier fondu*)."

The main line of demarkation here laid down lies in the capability to harden. Steel which will harden from any cause, that is to say, by heating to any temperature and using any quenching liquid, is termed weld steel. That which will harden by being heated to redness and quenched in water is termed steel.

Professor Kick, of Prague, after several experiments with nitric, sulphuric, and hydrochloric acids, and their combinations, with mordants composed of the salts of copper, etc., has arrived at the conclusion that a mixture of equal parts of hydrochloric acid and water, to which is added a trace of solution of chloride of antimony, constitutes a mordant especially applicable for the purpose of testing iron and steel. The last ingredient, which was recommended to him by Professor Gintl, renders the surface attacked more capable of resisting oxidation, and has the effect, after well washing with hot water and the application of a coat of protecting varnish composed of damar resin, of preserving the surface attacked sufficiently pure.

The method of proceeding is always to surround the surfaces, previously prepared by means of a file or hone, with a wall of wax fully ⅛ of an inch high, in the same way that copper plates are prepared for being eaten in with acid in engraving; the acid, heated to a temperature of 53° to 86° Fahr., is poured on to the surfaces, and soon begins to act, as will become manifest by the disengagement of gas. In winter, owing to the low temperature, the operation can not be performed so favorably. Its duration is usually from one to two hours, and it should be continued, as a general rule, until the texture of the iron be exposed. The progress of the action may be easily ascertained by pouring out the acid every half hour without breaking the wax border, removing by means of a brush or piece of rag the carbon (graphite) deposited on the surface, washing and again pouring on more acid if the action appears insufficient. If the chloride of antimony has been added to the acid in proper proportion, but little time will elapse, after the action has commenced, before it will begin to throw down a black precipitate. This is easy to distinguish from the graphite, inasmuch as the latter is not very appreciable, when, for about 1½ pint, is added only a single drop of the concentrated solution of chloride of antimony, which is sufficient.

When the action of the acid has been continued long enough the wax wall is destroyed, and the surface of the iron is washed by means of a brush with several waters, the first of which is rendered slightly alkaline by the addition of a little lye; it is then carefully dried, and a coat of varnish is applied. If at the end of a few hours there are any signs of oxidation, the varnish must be dissolved with spirit of turpentine, the oxide removed, and the varnish again applied.

The indications given by the different kinds of iron are as follows: Soft or fibrous iron: When of very good quality, this iron is attacked by the acid, even when the action is continued for several hours, in a manner so uniform, and with an elimination of the carbon so limited, that the surface acted upon retains a dull luster—a few incised specks and cinder-like holes being only observable.

Fine-grained iron gives exactly the same indications; the surface generally remains uniform, but it is not quite so bright.

Coarse-grained iron and hot-short iron are attacked by the acid with much greater energy than the two kinds above mentioned. Even at the end of about ten minutes the surface, especially that of the latter kind, becomes quite black. If the acid be allowed to act for nearly half an hour, a black muddy deposit (schlamm) may be removed by washing, and no amount of washing will prevent the surface from remaining black; there will also be a considerable number of small holes distributed over the surface. Some portions of the iron are generally attacked more deeply in this way; others, although they may have become black and a little porous, are better preserved. This appearance will be the more manifest if, after about an hour's action, repeated washing and drying, a fine file be passed over the surface.

Malleable iron or annealed iron becomes rusty, as is well known, more readily than wrought iron; but an interesting fact is that the action of the acid is very violent and irregular.

Puddled steel: The color, after being treated with acid and washing, is gray, and of a tolerably uniform shade, the weldings being but little apparent.

Blister steel: The appearance exhibited is very like that of puddled steel, and the weldings are also but slightly apparent.

Bessemer steel—cast steel: The surfaces of these steels are uniformly gray—the non-homogeneous parts are rare, and but little apparent. The softer the steel the more approaching to gray is the color. The action of the acid produces very fine fissures. In a sample of Mushet steel the prepared surface was perfectly uniform, but after the treat-

ment with acid narrow transverse fissures were observed over the whole extent. It is probable that the proportion of titanium in this steel was the cause that the surface attacked presented the dark gray color.

The old blacksmith's method of calling that steel which can be hardened, is one recognized method. To harden, however, is one thing, but to harden when heated to a definite degree is another, and to possess a definite degree of elasticity when tempered to a particular point of temperature after hardening, is yet another. So that in the absence of great uniformity in the grade of the metal, the blacksmith or the temperer must rely upon his judgment and perception. If under a given process the work is not considered hard enough, he may heat the metal to a greater temperature, providing its shape and size will admit of that without injury or causing it to crack in the quenching. In this case he will try to make up for the deficiency in the metal to temper by chemical additions to the quenching liquids.

Supposing that steel as operated upon be of uniform grade, the operation of the hardener would not always make it uniform, because steel decarbonizes somewhat by being heated, hence a small tool deteriorates by being heated in the open fire, and one often heated to sharpen or repair suffers in proportion. From all these and other considerations, hardening and tempering processes of steel differ according to the size and nature of the work, the amount of uniformity required, and the duty to which the work is to be put. The only information of value to the practical man is such as will instruct him in the practice of our workshops, giving the conditions and the processes in connection with each other.

IMPROVEMENT IN GAS ENGINES.

THERE is a considerable demand at present for engines of small power, capable of developing from ½ to 4 or 5 horse-power without the danger attending the use of steam, or the amount of personal attention required for stoking and keeping up the water level in a boiler. To meet this demand, a large number of gas-engines have been brought into use with great success, and with the advantage of reduced cost. A further recommendation of gas as a motive power is its adaptability to the requirements of the work; it can be turned on at any moment in full power, and can be shut off as soon as the demand for the driving power has ceased. This is specially useful to small machinists, who only require their driving power for a short time in the day, and for small printers and others who do not require the continuous exercise of driving power. In such cases to have full power at command immediately when the men arrive in a morning is of great importance to an employer.

The engine of which we give illustrations is on the Lenoir principle, and is manufactured by Messrs. H. S. Cropper and Co., of Nottingham, Eng. It is a horizontal engine, and is double-acting, which gives it a considerable advantage over the vertical Otto-Langen engine. That engine is single-acting, and allows the piston to be shot vertically upwards by the sudden explosion, a clutch being so arranged that the piston only engages in the shaft on the downwards motion. The action is thus but single in the down stroke, the flywheel being depended upon to preserve the constant rotary motion, thus giving an irregular and uncertain driving action.

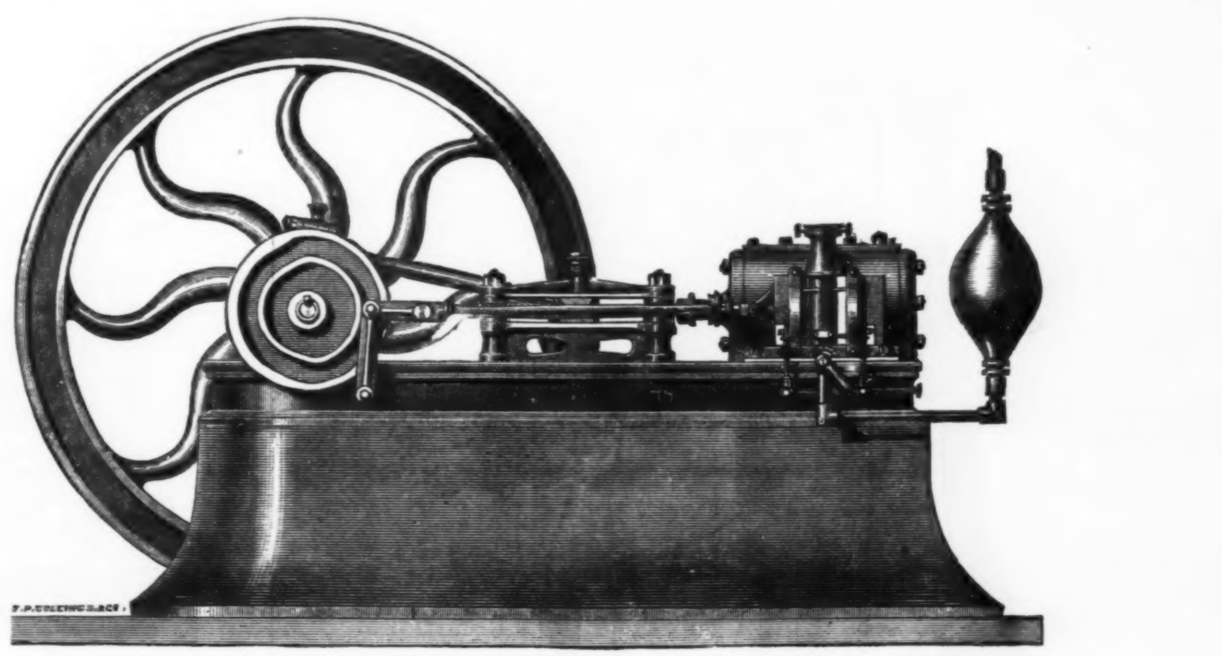
The Cropper "Lenoir" engine is arranged to receive charges of gas at each end of the cylinder, and is thus much more regular and constant in its action than a single-acting engine can be.

The general illustration, fig. 1, will show that the engine is similar in its arrangements to the ordinary horizontal steam-engine. The cylinder at one end of the bed plate is securely bolted thereto, and the double-acting piston, driven by the successive explosions, moves the usual connecting rod and crank, and upon the crank-shaft a fly-wheel and driving rigger may be keyed. This similarity of arrangement will prove valuable from the fact that workpeople are familiar with the ordinary steam-engine.

Referring to the detail illustrations, figs. 2, 3 and 4, it will be seen that there are two slides to the engine, one on each side, lettered respectfully B and C.

C is the feed-valve, to admit a charge of gas to either end of the cylinder alternately, where it is exploded by two gas-jets which are kept burning during work, and shown attached to the small gas-pipe, D. Messrs. Cropper and Co. had formerly an arrangement by which an electric spark was the agent of explosion, but this has been superseded. The ignition is now effected by the gas-jet, as shown in our illustrations. However simple and certain an electric arrangement might be, it would, in its management and repair, prove difficult to inexperienced or unskillful hands.

K is the inlet or feed slide-valve cover, into which gas is admitted through the inlet pipe, O, and is thus admitted by suitable ports through the slide-valve into the cylinder. This inlet pipe, O, is supplied with a gas regulator and handle shown at H, by which the supply of gas can be regulated, so that the admixture of gas and air may be in suitable proportions to produce explosion. The cover is kept down on the valves by two springs and studs and nuts, which serve to keep the faces gas-tight upon one another, and are most plainly seen in fig 3. An air-vessel is attached at F, probably to form a reservoir or cushion during the first explosion. The exhaust-valve is also a slide, B, on the opposite side of the cylinder to the inlet valve, C. This is also provided with a cover, J, kept in place by two outside springs, and through this the exhaust-products after explosion are ejected by the piston into the exhaust-pipe, P. The whole of the cylinder is double jacketed with a water-jacket which has an inlet pipe at M, and an outlet at N. Through this a constant stream of cold water may be kept up, so as to keep the cylinder and working faces cool. An oil cup is provided in the middle of the cylinder, as in the usual steam-engine. All the parts of this engine are simple and easily accessible for repairs or examination, and the reports of its working that we have seen are satisfactory in respect at once of economy, steadiness and noiselessness.



IMPROVEMENT IN GAS ENGINES.

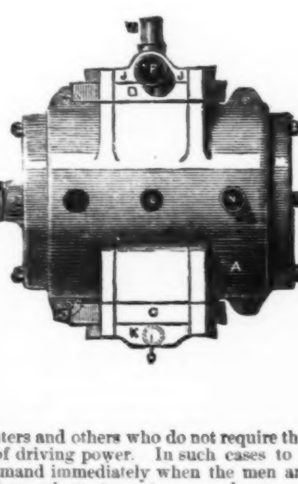
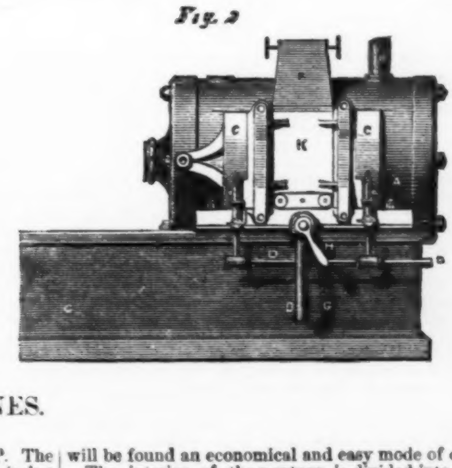


Fig. 3

Fig. 2



IMPROVEMENT IN GAS ENGINES.

THE LAURIA FLOATING DOCK.

THE following is a description of the system of floating dock introduced by an Italian engineer, the Cavaliere Ercole Lauria, as given in the *Atti del Collegio degl' Ingegneri ed Architetti*, of Naples:

This system of floating dock may be broadly described as divisible into two parts, the movable and the fixed. The former consists of a pontoon somewhat larger than the ship intended to be borne by it, and of a height proportionate to the weight of the ship. This pontoon may be made of oak or iron, and is sunk by the introduction of water; and when emptied is capable of floating beneath the superincumbent weight of the ship. The so called fixed part consists of a kind of dock, of a length somewhat greater than that of the pontoon, and generally sufficiently large to receive it. When it is desired to dock a ship, the pontoon is anchored in the open water outside the dock, such water having, of course, a sufficient depth to enable the pontoons, when sunk, to pass under the keel of the ship. From the end of the dock-wall nearest to the pontoon are extended india-rubber tubes in connection with the latter, by means of which tubes water or compressed air, as the case may require, can be pumped into the pontoon. In order to procure the level of the pontoon there may be fitted, if desired, certain guides or stays, but these do not form indispensable features of the design. On the upper surface of the pontoon are arranged parallel beams of iron which project considerably over the sides of the pontoon. The cradle for the ship rests upon these beams. When the pontoon is sunk the ship is towed into the cradle. A small portion of the water is then forced out of the pontoon; the pontoon then rises and adapts the supports of the ship. This accomplished, the floating of the pontoon is proceeded with until the ends of the beams float a little higher than the level of certain masonry ledges constructed along the parallel sides of the dock. The pontoon is then floated into the dock, and when in position is resunk, so that the beams carrying the cradle and ship ultimately come to rest upon the ledges of the dock-walls, and the pontoon may then be towed away to serve for the docking of another ship. When the necessary work is done, the pontoon is re-introduced into the dock beneath the beams, floated by forcing out the water, and the ship thereby carried out to the open water, where the pontoon may be resunk and the ship liberated. For the dock-walls may, if preferred, be substituted two rows of piles, strengthened by horizontal ties and fitted with the necessary ledges. This will be found an economical and easy mode of construction.

The interior of the pontoon is divided into twelve compartments, provided with in all twenty-four india-rubber tubes, twelve tubes being used for the water supply and twelve for the air. The air and water are discharged from the pontoon by valves placed in its upper surface. The water, of which there should be a sufficient head, is pumped by means of a steam engine into a reservoir placed about three metres above the sea level. The air is compressed in another reservoir to a pressure of three atmospheres.

The calculated dimensions for an iron pontoon to be used in docking ships of a thousand tons and under are as follows: Length, 75 metres; breadth, 18 metres; height, 2 metres; the weight of the pontoon proper being 276,000 kilogrammes. The volume of water necessary for sinking such a pontoon below the ship would be 2,700 cubic metres. The volume of air which would be required to drive out the water and float the ship would be 1,623 cubic metres. When the ship is floated, about 0·80 metres of the pontoon would be above the water. About 23 beams would be required, and in order that they may be sufficiently strong, they should be constructed of iron plates so as to constitute in section a rectangular tube of 1 metre in height. The time necessary for docking a ship would be about 6 hours.

NEW TYPOGRAPHIC MACHINE.

With all our contrivances for saving labor, it is strange that so long a time has elapsed before what is, perhaps, next to sewing, the most tedious of all manual operations, has been superseded by a more rational process. In copying manuscripts we still make the up-strokes and down-strokes, the pot-hooks and hangers of our childhood, using, on an average, three strokes for each letter, in very much the same way as the Egyptians of old formed their hieroglyphics with a reed on the flattened papyrus stalks grown on the banks of the Nile. It is probable that handwriting, in recording original ideas, will never be totally superseded, as many can compose with the pen, who could not readily dictate to others; but, the idea being once recorded, why should we so long have depended upon tedious or ununiform caligraphy for producing a small number of copies?

This need no longer be the case, however as the machine invented by M. Michael Alissoff, of St. Petersburg, and shown in action at the Caxton Celebration Exhibition, South Kensington, Eng., will produce a clear and uniformly printed copy of any document in the same time that it takes an ill-paid scribe to write one out laboriously with the pen; and this printed copy, if required, can be afterwa d multiplied to a practically unlimited extent. In 1867 the inventor of the

NEW TYPOGRAPHIC MACHINE.

machine obtained a patent from the Russian Government for an apparatus provided with keys corresponding to the letters of the alphabet, by simply depressing which letters were printed in succession on a piece of paper. M. Alissoff subsequently found, however, that the length of time occupied in original composition does not so much depend on the manual operation as on the mental process. He therefore gave up the idea of a machine for original composition, and turned his attention in perfecting an apparatus for producing fair copies in regular printing characters. The machine was entered at the Vienna Exhibition, and shown at Philadelphia; at the Caxton Exhibition, side by side with the original machine, is the first of a hundred now being made by Messrs. Pitt Brothers, of Liversedge, which is of rather simpler design. The accompanying perspective view, engraved from a photograph, will assist the reader in following our description.

The apparatus is about the size of an ordinary sewing machine, which it resembles as far as the stand, table, and treadle are concerned. The treadle, however, is used for drawing down a cylinder, A, carrying the paper on to a revolving drum, F, on the circumference of which the types are fixed. The printing takes place in a direction at right angles to the axis of the paper cylinder, one revolution of which corresponds to a line of characters on the paper. The same action also gives the feed in two directions, besides performing other operations.

On the table or bed-plate are fixed a pair of pillars with the adjustable conical centers, on which works the frame carrying the paper cylinder. The frame is drawn down by the treadle acting through the side rods, so as to bring the paper cylinder down upon the type drum, A, which is normally held clear of it by means of spiral springs at the sides. Two other pillars, with leather washers on the top, limit the stroke of the frame, and stops are provided for preventing the frame rising higher than necessary.

The type-drum is fast on a spindle mounted on a slide which works in V-guides, like the slide-rest of a lathe, and may be moved in and out by means of the handle, E, shown in front of the machine, one complete revolution of the handle bringing a different "font" of type into position for printing. The revolutions are easily counted through the clicking of a spring which engages in a notch in a disc fast on the screw spindle. Six rows of different types are fixed by set screws in grooves in the drum, and a handle, D, fast on the spindle, serves to turn the drum so as to bring upper-front marked with the different types and signs, like that of most any one that it may be desired to print. A fixed dial in a Wheatstone telegraph transmitting apparatus, serve to show which row of type is brought uppermost. As two cylinders at right angles to each other only touch at one point, so only one letter can be printed at a time. Between the type drum and the dial is an intermediate cylinder with six rows of screws, projecting, more or less, according to the width of the different types, the use of which will hereafter be apparent.

The inking of the types is effected by the type cylinder in its revolutions, turning the ink-roller, G, on the left, which takes its supply from another roller, which, in turn, takes it from a narrow disc. This disc is calculated to give just enough ink at a time, which it takes from a long roller, whose bearings are capable of sliding in and out so as to present a fresh surface to the disc when required. There is also another roller on the right of the type drum for taking the surplus ink off the type.

We have said that the treadle and slide rods give the feed motions. The drawing down of the paper cylinder frame turns, by means of a pawl, a ratchet wheel fast on a spindle at right angles to the paper cylinder, and causes it to make part of a revolution after each letter or sign is printed. Between the type drum and the feed spindle, which may also be turned by a handle fitted on its square end, for arranging on the paper the matter to be printed, are the bearings of a lever. One end of this lever carries a stop, adjustable by a screw, which strikes against the projecting screws on the continuation of the type drum. The other end carries a rod with a pawl at the end, which by an ingenious mechanical arrangement throws off the pawl from the feed ratchet wheel as soon as sufficient travel is given to the paper cylinder for the width of the particular letter that has just been printed.

On the top of the frame, and parallel with the paper cylinder, works a screw in bearings for causing the paper cylinder to travel along its spindle, thus giving the desired amount of space between the lines. This is turned by a handle, C, at the end, and a disc with a notch and spring facilitates the counting of the turns.

A warning of the near approach of the end of the line is given by a bell, the hammer of which is caught by a projection on the collar of the paper cylinder spindle. This collar can be adjusted on the spindle with a set-screw, so that the bell may sound at any given distance before the end of the line. An index on the cross feed spindle, pointing to a dial divided into 100°, also enables the operator to arrange the writing on the paper, as in the heading of a business letter, etc.

Though this machine is not intended for original composition, it will produce a well-printed copy in rather less time than is required to make a fair copy by hand; and this copy will yield two or three duplicates by being simply passed between rollers attached to the machine. If more are required, the first copy must be printed on prepared paper and transferred on to stone, as in ordinary lithography, when any number of copies may be printed off. The machine will be of great use in large establishments, where the principal is in the habit of dictating the letters to a shorthand clerk. The clerk would soon learn to print at once from his notes, and thus save a great deal of time, as well as produce clearer transcripts, for it is well known that the ordinary handwriting of stenographers is not very legible.

This machine affords, in fact, a printing establishment on a small scale, and on the premises—one which can be brought into use without any skill in composing, without much space, stock of type, or dirt; and which, at the same time, furnishes printed copies of any document at a much cheaper rate than letter-press printing, if the number of copies is limited. It possesses this further advantage, that all documents are printed in the office itself, thus insuring independence of the printer, secrecy if necessary, and also saving of time, as the first lithographed circulars may be sent out within an hour from the time they were written. The machine is capable of holding at one time all the types necessary to print two different styles of capitals and small letters, as well as figures and fractions and all the usual signs, so that two languages—for instance, Russian and English—may be printed by the same machine.

In conclusion, we may observe that there is nothing in the manipulation, either of the machine or of the lithographic process, that cannot readily be picked up by any intelligent office lad in a short time, and that no amount of carelessness will prevent all the copies from being fac similes.—*Iron.*

THE KLOTZ SAFETY-VALVE.

At the recent meeting of the Institution of Mechanical Engineers a paper was read on the improved safety-valve devised by Prof. Klotz, of Prague. Mr. J. C. Wilson, in his paper, made some general remarks on the construction of safety-valves, and then proceeded to describe in detail the Klotz valve, which has been improved by the Avonside Engine Company, who have fitted numbers of them to locomotives. The valve consists, first, of a seating that is not used to contain the movable part as in the ordinary safety-valve, but merely to fix the valve in its place, and to form the base of its superstructure, and to supply a passage for the escaping steam. Secondly, of a hollow cylindrical part, which is raised above this seating, and attached to it by feathers, and forms the guide to the movable part of the valve. Thirdly, of a movable part, which, instead of fitting within the seating, as in the ordinary safety-valve, fits outside of this cylindrical part. The cylindrical part is closed in the center to all except a pipe; also the movable part is closed at the top as usual, and there receives its load. Here is a radical departure from all previous constructions of safety-valves; and the movable part is not actuated by the escaping steam, but by the full pressure of steam within the boiler, especially

FIG. 1

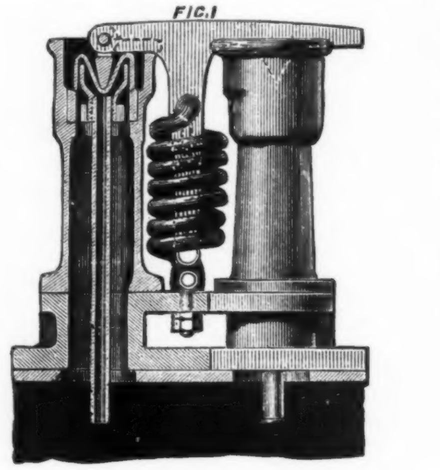
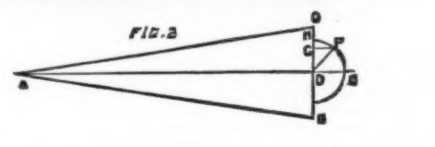


FIG. 2



conveyed to it by means of a pipe screwed into the solid center of the cylindrical part. The illustration in Fig. 1 shows this valve as arranged with Ramsbottom's lever and spring for locomotive purposes. The springs, as will be observed, are not subject to the action of the escaping steam; and means of easing the valve can be readily provided. Professor Klotz states that experiments were made on a boiler having 272 square feet of heating surface, with a 3¼ in. Klotz safety-valve, so loaded as to allow the steam to escape at a pressure of 70 lb. per square inch, and that when the valve had been shut the steam began to escape at 69½ lb., and it took forty-four minutes of continued forced firing of the boiler, during which time the steam escaped violently from the safety-valve, before the pressure was got up to 76 lb., after which it could not be made to rise any higher. Another ordinary safety-valve of 2⅞ in. diameter upon the same boiler was then allowed to be the only escape for the steam; it was loaded in the same way, steam began to escape at 68½ lb., but after moderate firing during seven minutes the steam rose to 76½ lb., after which it rose so rapidly that to prevent danger the Klotz valve was put in operation. The correctness of the above statement has been tested by the Avonside Engine Company by a trial with two engines in the erecting shop. The two engines were similar, and had exactly the same Klotz safety-valves, only the pressure pipes were taken away from one of them so as to change the action of the Klotz valve into that of an ordinary safety-valve. When steam was up, and the firing continued, there was a very marked difference in the behavior of the two boilers; the pressure in the one with the Klotz valve could not be got higher than a certain point, whereas in the other the steam continued to rise until it was found necessary to stop the trial. In concluding his paper Mr. Wilson said he thought the subject was an important one, and deserved discussion in the interests of the public safety. Mr. Webb pointed out that in one of the specimen valves shown a wedge might be placed between the two parts of the casing of the spring, which would practically lock the valves. He also thought that with a priming boiler the valve would be quickly blocked by incrustation. Mr. L. Olrick, after pointing out that there was no "radical departure" from other forms of valve, and that in principle Bodmer's valve,

invented upwards of fifteen years ago, was identical with Professor Klotz's, gave a brief description of the "Paragon" safety-valve, the joint invention of Mr. Edward Field and himself, the object of which is to counteract the additional pressure brought to bear by the extension of spring by means of a compensating lever, so arranged that as the valve rises the power exerted by the spring to draw it diminishes. The advantages of the principle were shown by Mr. Olrick, who cited an experiment in which a locomotive was fitted with a pair of 5 in. spring valves and a Paragon safety valve of only 2 in. diameter; the two 5 in. valves allowed the steam to accumulate up to a pressure of 145 lb., although set to blow off at 100 lb., whereas the Paragon, under the same circumstances, only allowed the steam to rise to a pressure of 105 lb. The reason of this was that the two 5 in. valves have a circumference of nearly 32 in. each, and as the valves do not lift more than one-thirty-second of an inch, only 1 square inch is open to the atmosphere for letting out the steam; in the Paragon, however, the circumference of the 2 in. valves is only 6 in., but the lift is ½ in., giving an outlet for the steam of 3 square inches. The conclusion to be drawn from this experiment was strongly urged by Mr. Olrick, who said he preferred always to put several small valves rather than one large one, meaning, of course, valves of the same construction, for in the experiment cited the one small valve is of more service than the two large ones. Several speakers followed, some of whom expressed confidence in the ordinary valve when properly proportioned, and thought that Mr. Wilson had dealt hardly with it; others expressed the belief that the Klotz valve would corrode up. In reply to a question as to the rise of pressure in a locomotive when steam is suddenly shut off with a good fire in the furnace, Mr. Webb said that it was not more than 5 lb. or 6 lb. with a pair of Ramsbottom valves of 3 in. diameter. He had recently made an experiment on a large locomotive boiler, fired hard, and found that all the steam generated was discharged through a ¾ in. pipe, without raising the pressure more than 10 lb., while an inch pipe was sufficient to discharge it as fast as generated, without raising the pressure, which was, however, very high to start with, it must be noted. Mr. Thomas Adams created some amusement by the vigor with which he denounced both the ordinary valve and the Klotz, and he asserted that the latter would never be passed by a Board of Trade surveyor. Speaking of dead-weight marine valves and the ordinary valve, he stated that the best of the former he had ever seen allowed the pressure to rise from 60 lb. to 75 lb. while blowing off, and some of the worst valves allowed it to rise from 60 lb. to as much as 120 lb. He alluded to the "beautiful principle" of the Ramsbottom valve, by which, owing to the point of attachment of the spring to the lever being below the level of the points pressing on the valves, when one valve opened it tended to relieve the pressure on the other; whereas if the point of attachment had been higher, the opening of one valve would have put a greater weight on the other. Mr. Adams gave the graphical method of determining the dimensions of helical springs shown in Fig. 2. Draw A D equal to the length of spring, and describe an isosceles triangle, having the angle B A C equal to 15 degrees. Take two-thirds of B D as radius D E, describe the semicircle, and set off the angle E D F equal to 60 degrees; draw F G, which gives the pitch of the coils, and H G is the side of the square of the steel of which the spring should be made. The formula accepted by the Board of Trade is $d = \sqrt[3]{\frac{S \times D}{c}}$ in which S = load in pounds, D diameter of spring, and c a constant, 11,000 for square and 8,000 for round steel, d being the side of the square or diameter of the round steel, of which the spring is to be made. Later on, Mr. Adams corrected a statement as to the expansion of brass and cast iron, pointing out that it depended upon the mixture of brass used—that which he employed expanded 1·46 times as much as cast iron at a temperature of 212° Fahr. Mr G. B. Marten called attention to the fact that many common valves did not close promptly, which led to their being overloaded. Mr. Wilson, in reply, said that, as regards locking the valves, the cases of the springs exhibited should have been so fastened as to prevent the introduction of a wedge, while as to the sticking, the Klotz valve had not been found liable to that, and boilers ought not to prime. As a matter of fact, however, boilers do prime; and taking into account the relative advantages of the Klotz as compared with the Ramsbottom valve, it must be confessed that the superiority of the former is not clearly established.

THE REMARKABLE MOUNTAIN LUMBER FLUMES OF CALIFORNIA.

THE Sierra Flume and Lumber Company was incorporated under the laws of the State of California, November 11th, 1875. The object was to engage generally in the manufacture of the Sierra mountain timber into lumber, and also to manufacture the lumber into the various forms for which it is adapted. The operations of the company are of a magnitude scarcely to be imagined by those who have given the subject no attention, and the whole undertaking is so varied in its different departments as to form an interesting subject to the public.

The slopes of the Sierra Nevada are covered with immense forests of pine, spruce, and fir timber, which until now has been scantily utilized, the lumber mills of the northern coast furnishing all that material used east of Sacramento. For nearly a hundred miles in length in the counties of Butte, Tehama, Plumas, and Shasta, the Sierras are covered with a heavy growth of timber of the varieties mentioned, and the Sierra Flume and Lumber Company was organized to cut this timber, ship it to the mills, and prepare it for market. The difficulties of carrying out the idea would not be apparent to those not familiar with the region mentioned, but they were such that it required a large expenditure of capital, such as a powerful company alone could afford to make, to carry out the plan in all its details.

The timber supply of the company lies along the west slope of the Sierra from Butte Creek, in Butte County, to North Battle Creek, in Shasta County, and also around Deer Creek and Big Meadows, Plumas County, and the timber area is said to be ample for fifty years' operations. If the pine and fir of this region do not reach the majestic proportions of the *sequoia gigantea* found in Mariposa, Calaveras, Fresno, and more southerly sections of the State, they attain an extraordinary size, and are perhaps more valuable as articles of commerce and for administering to the wants of man. Of this area of country, considerable more than one-half is occupied with timber, which can be manufactured into merchantable lumber. The remainder consists of scrub timber and cord wood, and at intervals occur those valleys or basins of tillable land and meadows met with on the western slope of the Sierra. The best timber is found at an altitude of from 3,500 to 6,000 feet, up to the snow line. Until a comparatively recent period nothing but the very fringe of this timber country was explored. No use was made of these magnificent forest trees which abounded in such quantities, except where they happened to be located near a mining camp. And then only such small portions were felled as were necessary for the purposes of mining work or for fuel. This whole tract of country, with its wonderful sugar pine, yellow pine, spruce, and fir, was regarded as comparatively worthless. It is only recently that the light began to dawn upon our lumbermen that California had within its own borders, lying neglected, a class of timber equal to any imported from the East for the manufacture of flooring, doors, and window sashes. The well-known and useful redwood was supposed to comprise the valuable lumber resources of the State.

The sugar pine taking the place of Eastern white pine, and equal to it as finishing lumber, is used exclusively by the company for sash and doors and outside blinds. For all finishing lumber, and for all uses where a soft and straight grain is required, there is no wood grown on the coast to take its place. The heart is desirable for shingles, railroad ties, etc. It is largely used for box, trunk, and other manufacturing lumber. Heart sugar pine shingles are free from some of the objections of redwood shingles, and make an equally desirable roof.

The yellow pine takes the place of soft pine for many purposes; is a soft, white, even grain, but works a little harder, and is a firmer wood than sugar pine, much of it resembling sugar pine so closely as to be scarcely distinguishable from it. For flooring, rustic, stepping, ceiling, wainscoting, pickets, etc., it is superior to any wood grown west of the mountains, and in appearance is all that could be desired; some of it is as handsome as many of the ornamental woods. For building lumber, fencing, etc., it is generally preferred to sugar pine; for all interior work, for finishing purposes, such as windows and door frames, base boards, etc., no better lumber can be found. It is also largely used for box lumber. The heart makes good railroad ties.

The spruce (sometimes called red fir) is a strong timber adapted for scantling, joists, timbers, and work requiring strength and durability; it stands exposure to the ground or weather. This wood is much the same and equal in all respects to Puget Sound lumber, making good railroad ties, foundation and bridge timbers, flooring, and fencing. For heavy plank sidewalks, platforms, ship plank, car floors and frames, and similar work, it is specially adapted. It makes good laths that do not stain, and is also very useful for shelving, being free from pitch or odor.

The fir (sometimes called white fir) is useful for fencing, ceiling, wainscoting, scantling, and makes excellent box lumber. It is free from odor and pitch. In color the wood is white, and makes laths which do not stain.

The cedar is used chiefly for fence posts, and is equally durable with redwood—it is, in fact, a variety of redwood.

With large tracks of timber of these varieties, the next consideration of the company was the means of transportation. After the value of the wood was admitted, the freighting of the lumber from the mountains to the towns and cities would make it so costly as practically to exclude its general use. It was clear that no logging camps could be run at a profit where roads had to be constructed and kept in order in almost inaccessible regions, and the lumber hauled for fifty miles to a market. The V flume then came into requisition. These flumes are built V-shaped, and are intended to float the lumber, etc., down from the forests to the yards. The engineering obstacles alone were difficult to overcome, being somewhat different from railroad engineering. In a V flume the grade must be continuously downward—as, of course, the water will not run up hill—although the grade varies along the line. In some places immense trestles are made to carry the flume, which makes the undertaking expensive. This class of flume costs $1,500 to $2,500 per mile, but answers the purpose admirably.

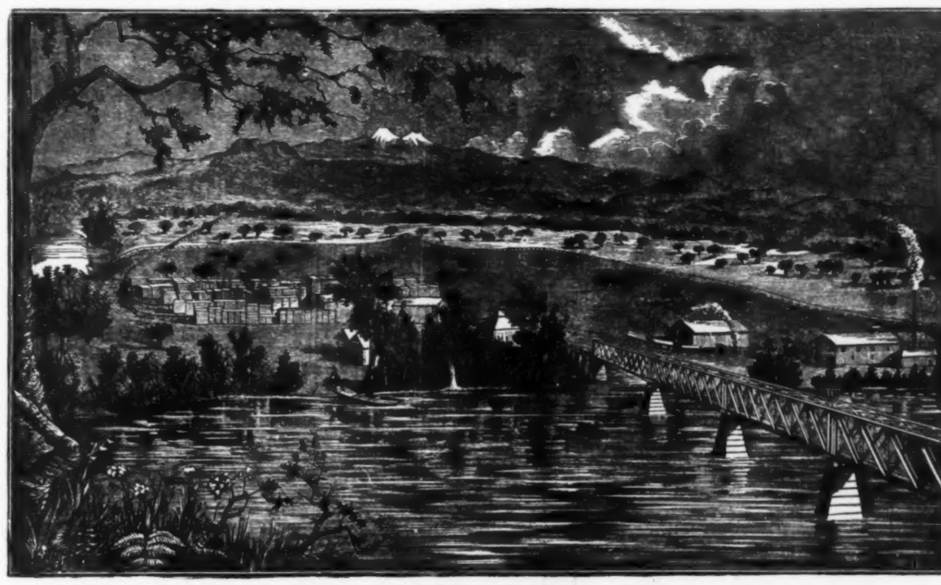
In addition to the flumes necessary to carry out the operations, sawmills had to be built, railroad tracks laid at the yard, telegraph lines constructed, and all the necessary details carried out for transacting the business of the company. The result has been the successful organization of a company second only in magnitude in the State to the Central Pacific Railroad Company. Not only does this bring into full development the timber resources of the State, but the public are insured a constant supply of sugar and yellow pine at rates much below those which have hitherto prevailed. The consumers of sugar pine have heretofore paid very high prices, so that comparatively few could afford to use it.

The company is now operating over 150 miles of V flume for lumber transportation: one flume on Chico Creek, terminating at the town of Chico; one on Antelope Creek, terminating at Sesma; and one on the waters of Battle Creek, terminating at Red Bluff. On these flumes there are ten sawmills in operation, with an estimated capacity of between 300,000 and 400,000 feet daily. The Moscow Mill is one of the largest, and is at the head of the Red Bluff division. The Defiance Eureka and Clipper mills send their lumber by branches into one main flume, which delivers the lumber at Red Bluff.

On the other ridge is the Chico flume, which carries the lumber for the Cascade, Arcade and Belmont mills. The Arcade Mill was burnt not long since, but has been rebuilt. The Champion and Last Chance mills float their lumber into Sesma.

The mills in the mountains and the yards in the Sacramento Valley are connected by telegraph lines, and arrangements are complete for filling orders as quickly as if the mills and lumber were on the railroads. The telegraph system extends along the flumes, so that the section men can advise one another of any "jams" in the flume in case any occur.

The accompanying engraving which we have prepared shows the works of the company at Red Bluff, at the bend of the river and opposite the town. The bridge shown connects the works with the town. The flume coming down from the mountains branches off into several divisions in the yard for convenience in separating the lumber and piling. The office of the company is seen among the trees by the river, and right in front of it is where the flume empties into the river. The storehouses, stables, etc., are also shown. The railroad tracks wind about in the yard and run across the bridge, connecting with the Oregon division of the Pacific Railroad. The flume is seen winding down from the mountains in the distance. This is one of the principal termini of the company. On the right is shown the large sash and door factory and the fully equipped planing mill. The company have also a planing mill at Sesma, and a large sash and door factory at Chico, with a capacity of 200 doors, 100 windows, and 50 blinds daily; also a large planing mill for the manufacture of flooring, rustic, ceiling, shingles, laths, pickets, mouldings, brackets, etc. It is the purpose of the company to manufacture and keep on hand an ample supply of seasoned lumber, and to reach the consumer through dealers, and manage its business as manufacturers merely. A full stock of all kinds and dimensions of lumber is kept, so that an order for all parts of a house may be filled at any time. The facilities for rapid shipment from the mountains and by rail offer unusual opportunities to the trade for supplying demands, without carrying large stocks of lumber in yards.



THE MOUNTAIN LUMBER FLUMES OF CALIFORNIA.

As will be seen by what we have said, this lumber enterprise was inaugurated at large cost, in the belief that the supply of the Sierras could be brought into market at prices to compete with the most favorable terms of other manufacturers. The company pay out about $450,000 per annum, and are continually increasing their facilities. They employ over 500 men, 500 head of work cattle, 100 horses and mules, 37 logging trucks, 24 wagons, and cut 30,000,000 feet of lumber in 1876. This year they will cut over 50,000,000 feet. We have by no means given a detailed account of the company's operations, and shall take occasion to recur to the subject again.—*Min. & Sci. Press.*

IMPROVEMENT IN METHODS OF REPAIRING STRUCTURES WITH BETON OR CONCRETE.

By JOHN C. GOODRIDGE, JR.

THIS invention relates to the repairing, strengthening, replacing, protection, and preservation of structures formed wholly or in part of stone, brick, metal, or of rock, in its natural position by the employment of beton or concrete. Repairs may become necessary from imperfect construction, disintegration: oxidation, friction, pressure, or concussion.

The material to which the beton is to be applied should first be carefully cleaned, the joints thoroughly raked out, and all loose fragments removed. It should then be washed with a mixture of lime and water and a small quantity of cement. This assists the beton in forming a bond. Care should be taken that no unslaked lime gets into the work. Molds of wood or metal, or a wall masonry, are then placed, and firmly fastened and braced, at a distance from the old structure or material, decided upon as the proper thickness of the beton. The mold is then filled with beton, layer by layer, and thoroughly rammed and forced into all joints, crevices, irregularities, and inequalities of surface. This process is continued until the beton is carried as high as necessary. After the beton has set, which will be in from two to ten days, the molds may be removed.

A mold is placed in the arch, and at a proper distance from it. The space between the arch and mold is then carefully filled with beton. This attaches itself to the arch and fills all joints and irregularities, so that water cannot get between it and the old structure. A new structure may be

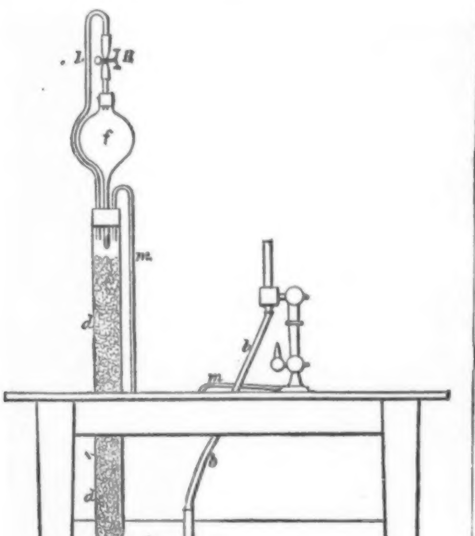
made by first placing a lining of beton and then placing the stone or other material upon that. When the top of an arch to be repaired is accessible it may be uncovered, all old filling removed, and the beton placed upon the old structure, using it as a mold. The method of replacing a foundation is that one section is removed and replaced with beton; and so alternately, or they may be taken in regular order if time is allowed between each replacement for the beton to harden. In this manner any structure or its foundation may be replaced, section by section. The beton, completely filling the space occupied by the material removed, prevents any settling, and allows the structure to be used for the purposes for which it was constructed during the time occupied by its repair. If the surface of a structure is deteriorating, or not strong enough, from any cause, or if water, getting inside, separates its component parts, as happens particularly in river piers and abutments, it may be entirely in cased in beton and its whole surface covered.

GAS GENERATOR AND BLOWPIPE.

BY ALEX. C. THOMSON.

THE following sketch of a gas generator for use in connection with a blowpipe will prove very serviceable in laboratories not supplied with gas.

a is an ordinary foot bellows; *b*, branch tube for supplying air to blowpipe; *c*, air tube leading into ditto; *d*, wide glass tube filled with pumice stone; *f*, reservoir containing a light liquid hydrocarbon, the lower tube being drawn to a point and stuffed with a little sponge to allow discharge only by drops into *d*; H, clip for stopping discharge of



liquid; L, the tube to equalize pressure on both surfaces of liquid; E, reservoir to catch excess of liquid; M, tube leading off air charged with inflammable vapor; K, wooden support fixed to table.

A light mineral naphtha obtained from the coke towers of paraffin oil works is exceptionally suitable as a source of gas.

Those who can do a little glass blowing may construct the whole thing at a cost not exceeding three shillings, exclusive of the ordinary blowpipe fittings, and not inferior to a blowpipe supplied with coal-gas in the ordinary way. —*Chemical News.*

RICE HULLING AND BRUSHING.

RICE mills, or mills for hulling rice, form a distinctive feature in the milling of some of our southern states. These mills when of any considerable size are almost invariably situated on the banks of some navigable stream, in order to facilitate the receiving of rough rice and the delivery of the cleaned article. The method and means by which the rice is hulled have varied but little since the days of Oliver Evans, who described the process in his work on milling published many years ago. Still the minutiæ of the process have been changed somewhat, and the rice mills of the present day are vast improvements over those which existed in the days of that worthy old pioneer of American industry.

When rough rice is sent to the mill to be pounded, elevators are lowered into the vessel, and the rice is transferred into the mill by horizontal screws. It is then elevated into the highest story of the mill, and run through screens, which operation frees the rice from such foreign matter as small sticks, straws, dirt, etc. The rice is then passed to large millstones which are generally six feet in diameter and revolve at a speed of about 120 revolutions per minute. The stones should be dressed with a few deep furrows, with but little draft, and picked full of large holes. They must be set more than the length of the grain apart, as the principle on which the grains are hulled is that of rubbing them against each other between the stones with great force, by which means they hull each other without being broken by the stones. From the millstones the rice passes through a fan which blows the separated hulls into an apartment provided with spouts which remove them from the building. After being subjected to the action of the fan, the rice is conveyed to bins located above the mortars.

* These mortars are, we believe, peculiar to rice mills. They are made of wood, are egg-shaped, and lined with Russia iron. They hold about four bushels each, and are provided with pestles made of heavy timber eight by twelve inches on end, ten feet long, and shod with a heavy iron boot. The pestles are raised by a shaft in the rear, and are dropped about two feet and a half into the rice in the mortars. The object of this pounding operation is to reduce to a flour the coating or skin which was left on the rice by the mill stones, and it is continued from one to two or more hours, according to the quality and condition of the rice.

After the pounding process is finished, the rice is again elevated to the upper portion of the mill and passed through screens which remove nearly all that is left of the adhering flour. It is then sent to other screens, which divide it into three grades, whole, middling, and small, and is next sent on to the brushes. These brushes are cylindrical wooden drums, from two to three feet in diameter and from six to ten feet high. They are placed in an upright position, the spindles running through an iron bar, and long enough to pass the floor so as to present easy access for oiling. The drum is covered lengthwise with strips of sheepskin, wool side in, about a foot and a half long and a half foot wide, backed on one side only to the drum, and each slip lapping a little the one next to it. The cylinder is then enclosed by a wire screen which is fastened securely into its place. The brushes, three feet in diameter, revolve at a speed of about 300 revolutions per minute, and those two feet in diameter at a speed of 450 revolutions. From the fans last mentioned the rice goes to the brushes, passing between the wire screen and the covering of skins. The motion of the brushes causes the loose edges of the skins to rub the grains against the wire screens, driving the flour through the screen and polishing the rice. The grain is brushed according to grade, as previously separated by the screens, and passes by spouts to tierces, each standing on a platform so arranged that a slight motion up and down is imparted, which packs the rice as it falls into the tierce. As soon as it is full, it is removed, headed, branded, and is then ready for shipment.

Care is taken to prevent the grain from becoming wet, as fresh water softens the grain so much that it heats or sprouts, or at least never recovers its original hardness; while, if dampened with salt water, it acquires a very offensive smell. Many of the rice mills in the Southern States are large and fine structures, built in the most substantial manner, while the business of hulling rice is an important and profitable industry.—*American Miller.*

CINNAMON.

THE finest and most esteemed variety is the Ceylon cinnamon, which is obtained from the *Cinnamomum zeylanicum*, Blum, chiefly as cultivated along the southwest coast of Ceylon. It is collected from shoots about two years old, the bark being deprived of its external layer by scraping it down to an almost uninterrupted circle of hard and thickened cells, after which several layers of the remaining bast tissue are dried together, forming a rather solid compound quill. It is of a light yellowish-brown color, smooth upon the outer and inner surface, and upon the former with faintly glossy lines. Similarly prepared is the true cinnamon, which is cultivated in Java and other tropical countries; but none is fully equal in flavor to that from Ceylon, though in appearance not unfrequently quite as handsome.

OBTAINING COLORING MATTER FROM COAL.

DURING the past few years the coal tar colors have been in much favor, and the various chemists have given great attention to their production. Dr. Meusel, of Breslau, has now invented a process according to which fossil coal, cannel, anthracite, or boghead coal are treated advantageously in fine powder with oxidizing chemical compounds by ordinary or higher temperatures in suitable vessels. The most advantageous method of carrying out these improvements is to heat the different coals finely powdered with nitric acid or with potassic or sodic nitrate, and sulphuric acid. Also potassic chlorate, or potassic chromate, or hypochloride of lime, or compounds of manganese, may be used for the reaction with or without an acid. By the action of nitric acid, or nitrates with acids, compounds of nitrogen with oxygen are developed, which are to be used in the manufacture of sulphuric acids or salts, containing nitrogen bound to oxygen.

Coals treated in this manner undergo a great change; a great part of the coal can now be extracted by caustic alkalis, and by ammonia or by the carbonates of soda, or potassium, or ammonia, advantageously by heating the solution of alkalies with the product of the above treatment, a deep brown colored solution and a black residue is so obtained. The black residue is a deep black covering color which may be used for lime color (glue color) or oil color, with bone black, or instead of bone black, soot or graphite. It may also be applied for the black for printing, or for blacking, and washing, painting, besprinkling, or other like purposes. The brown solution of the alkali salts may be used directly for coloring, for instance, by fluids, by soap, or otherwise. The solutions give by evaporating the alkali salts, and by decomposition with metallic salts, new salts of metals which are to be used as colors.

By the method of decomposition the salts of strontian, of barium, of magnesia, of aluminum, of manganese, of iron, of cobalt, of nickel, of zinc, of cadmium, of lead, of tin, of copper, and chromic oxide are obtained. All these bodies are black or black brown or brown colors, which may be mixed with other coloring matters. They can be used for painting, printing, and coloring. These colors are obtained as precipitates and can be purified by water. The alkali solution can also be decomposed by the soluble metallic salts above (cotton or wool) and may so be used by the dyer. The alkali solution can also be decomposed by acids; a black brown precipitate is obtained which may be washed in water, and which may also be used as a coloring matter. This black precipitate is the acid in which the coals are partly converted by the treatment with oxidizing compounds. By these means fossil coal is oxidized, and the black residue obtained by the decomposition of the oxidized fossil coal may be applied as a color ng matter to various useful purposes. The product of the oxidation of fossil coals is soluble in alkalies, and the compounds of this product of oxidation may be applied as a coloring matter to various useful purposes.

DR. H. SOXHLET'S PROCESS FOR MAKING BUTTER.—The author finds that this process, which consists substantially in freezing the cream before churning, produces butter in less time than the ordinary process. There is, however, a loss in quantity.

EXTRACTION OF SILVER FROM CYANIDE BATHS.

M. DE BIBRA.

Baths of silver cyanide, the residues from galvano-plastic establishments, are precipitated with sulphuric acid. The precipitate contains all the silver, along with copper, zinc, and iron. It is ignited, and the residue is treated with nitric acid, which dissolves out the silver, zinc, and copper. From this solution the silver is thrown down as chloride. The portion insoluble in nitric acid contains carbon, ferric oxide, and traces of silver, which may be extracted with ammonia. —*Journal für Praktische Chemie.*

BRONZE FOR IRON.

M. P. HESS.

THE articles to be bronzed are heated in the air after being coated with linseed oil. Objects which cannot be exposed to a high temperature may be steeped in a slightly acid solution of ferric chloride, plunged in hot water, and when dry rubbed with linseed oil or with wax. To preserve iron from rust the author recommends sulphide of copper. He steeps the iron for a few minutes in a solution of sulphate of copper, and then transfers it into a solution of hyposulphite of soda acidulated with hydrochloric acid. The result is a blue-black coating, not affected by air or water.—*Deutsche Industrie Zeitung.*

REMOVAL OF STRONG ODORS FROM THE HANDS.

THE *Schweizerische Wochenschrift für Pharmacie*, 1877, has a communication from F. Schneider, in which he states that ground mustard, mixed with a little water, is an excellent agent for cleansing the hands after handling disagreeably or odorous substances, such as cod-liver oil, musk, valerianic acid and its salts. Scale pans and vessels may also be readily freed from odor by the same method.

In a succeeding number of the same journal, A. Huber states that all oily seeds, when powdered, answer for this purpose. Flax-seed meal, for instance, removes odors as well as mustard. The use of ground almond-cakes as a detergent is well known. The explanation of this action is somewhat doubtful, but it is not improbable that the odorous bodies are dissolved by the fatty oil of the seed, and emulsionized by the contact with water. In the case of bitter almonds and mustard, the development of ethereal oil, under the influence of water, may perhaps be an additional help to destroy foreign odors. The author also mentions that the smell of carbolic acid may be removed by rubbing the hands with damp flax-seed meal, and the cod-liver oil bottles may be cleansed with a little hot sesame or olive oil.

A NEW METHOD OF DETECTING ALCOHOL, WHEN USED AS AN ADULTERANT OF THE ESSENTIAL OILS.

By EDMUND W. DAVY, A.M., M.D., M.R.I.A.

Professor of Forensic Medicine in the Royal College of Surgeons, Ireland.

IT is well known that one of the most frequent of the adulterants of the essential or volatile oils, at least of those that are the most expensive, is alcohol; this being the case, at the suggestion of my friend Mr. Charles Tichborne, I made some experiments on the application of my molybdenum test for alcohol to the detection of that substance when used for such adulteration; and finding that it might be usefully employed for this purpose, I brought the matter under the notice of the Pharmaceutical Society of Ireland, at its meeting in last April. A number of circumstances, however, prevented me from publishing before this my communication on that subject.

Having briefly described the molybdenum test for alcohol, which was published last year in the *Pharmaceutical Journal*, *Chemical News*, and in other scientific periodicals, I pointed out how it afforded a very ready means for the detection of alcohol in the essential or volatile oils, it being only necessary to agitate a little of the oil under examination with a small quantity of distilled water, and having allowed the mixture to stand for a short time till the oil and water have again separated, to take a drop or two of the watery portion and add to it three or four drops of a solution of molybdic acid in strong sulphuric acid, when the characteristic blue reaction will appear if alcohol be present. The following very simple way I adopted in applying this test to the essential oils:—A glass tube of about four inches in length and of about a quarter of an inch in diameter in its internal bore was taken, one end of which being heated was drawn out to a point, and closed so as still to leave a very small hole, whilst the edges of the other end were merely rounded by fusion,* and to this latter was adapted a sound well fitting cork, or, better still, an india rubber stopper capable of closing the aperture perfectly airtight. The small hole being closed by one of the fingers placed firmly against it, the tube is filled to about one third† of its contents with distilled water, and then about an equal volume of the essential oil added. The larger end of the tube is now to be tightly closed with the cork or stopper, the finger being still kept on the small hole, and the contents of the tube is then strongly agitated for a few moments; after which the pointed end is turned upwards and the finger removed, to allow the air condensed by the closing of the larger end to escape so as to avoid unnecessary loss of the mixture; and finally the tube being again reversed, it is supported on a stand with its pointed end downwards, but not resting on it. In this upright position it is left till the oil has separated from the water and risen to its surface, which in most cases takes place in a comparatively short time, leaving the aqueous portion below quite clear or very nearly so. When such is the case a drop or two of this portion is allowed to escape, which is easily effected, either by pressure on the cork or stopper, by holding the upper part of the tube in the hand so that its warmth may expand the contained air, or by slightly drawing out the cork (which will cause some air to enter at the pointed end) and then pressing it in again; by one or other of those simple means, the necessary quantity of the aqueous portion

* Several tubes suitable for this purpose may be easily made by selecting a tube of rather soft glass, not too thin in its substance and of about the bore stated; and having with a spirit lamp or by means of gas drawn it out to a fine bore at intervals of about eight or nine inches apart, the tube is cut with a file, both at the centres of contraction and of the intervals between them and finally the edges of the larger end of each tube rounded and of the smaller one closed to a fine point of fusion.

† In cases where the degree of adulteration may be small, it will be well to diminish the proportion of the water employed so as not to dilute the adulterant too much; and where the very expensive oils are the object of examination, smaller sized tubes than those recommended may be employed.

will be easily forced out of the tube. This, on being brought into contact with three or four drops of the molybdic solution placed in a little porcelain capsule or on any white porcelain or delf surface, will, if the oil has been adulterated with alcohol, develop after a few moments the characteristic intense blue reaction of that substance.

The molybdic solution I have employed for this purpose was the same as that which I have already recommended to be used in the adoption of my test for the detection of alcohol generally, which is readily prepared by dissolving, with the aid of a gentle heat, one part of molybdic acid in ten parts by weight of pure and concentrated sulphuric acid. This solution should be kept in a well-stoppered glass bottle, as it quickly absorbs moisture, becoming too dilute, and is otherwise injured if it is left exposed to the air.

As regards the little testing tube I have suggested for the examination of the essential oils, I may observe that if it is properly constructed and corked perfectly air-tight, it will hold its contents without allowing it to drop out when not required; and if the pointed end of the tube is not left touching any object, which would withdraw the fluid by capillary attraction, there will only be a very trifling loss of the watery portion from evaporation through the small aperture, even after keeping for a considerable time.

The experiments I have made on a number of the essential oils,* which were apparently pure, or at least were unadulterated with alcohol, show that if they are agitated with distilled water, and after they have again separated from it a drop or two of the watery portion be taken and tested in the manner already described, there will either be no change of color observable, or what is more frequently the case, there will be a faint light-brown or yellowish-brown tint produced, or lastly, in some few instances a light olive or grey is developed, quickly changing to the former tints, all of which soon fade away, leaving the mixtures colorless or very nearly so. But if the oil is adulterated with alcohol, the water dissolving out that substance, a drop or two of the aqueous portion develops with the test solution, after a few moments, the deep azure coloration which is so characteristic of that substance, and this is much more permanent, generally speaking, than the shades of color caused by the essential oils alone when so treated, though even this, as in their case, will fade away, leaving the mixture colorless, or very nearly so, after a shorter or longer exposure to the atmosphere.

If the amount of alcohol present be considerable, the blue effect will be produced after a few moments, even at the ordinary temperature, but where the quantity is very small I have found that the application of a very gentle heat renders the test far more sensitive.

As, however, I have ascertained that a heat of 212° Fahrenheit, and in some cases a temperature even considerably below that point, especially if continued for some time, will develop a more or less blue coloration with the water which has been agitated along with essential oils apparently pure. When it reacts on the molybdic solution, some caution must be observed in the application of heat.

It appears, however, from my experiments with the essential oils I have operated on, that the water so treated and then allowed to separate from them, as in this method of testing, might be heated with the molybdic solution to 120° Fahr. on a water-bath, without developing a blue coloration, at least, unless that heat is continued for a considerable time, though such a comparatively low degree of heat is quite sufficient to develop, almost immediately, the blue reaction if alcohol be present. But owing to heat acting in the manner described, I would recommend the test to be at first applied at the ordinary temperature; and if it fails to indicate the presence of alcohol, it shows that either the oil is free from that substance, or if any is present the quantity must be extremely minute, and if the latter is the case it may be readily detected by a slightly warming of the mixture, taking care, however, that the heat should not rise much beyond 120° Fahr., which, if it occurred, would create some uncertainty as to the cause of the blue reaction.

By means of this test I have ascertained that several samples of otto of roses sold to me as genuine were adulterated with more or less alcohol, and that a sample of rose geranium oil lately in the market, which was assured to Mr. Tichborne as being a genuine article and one of superior quality, was very largely adulterated with alcohol. From several experiments I have made with the more expensive essential oils, mixing them with different proportions of alcohol, I found that where they were mixed with one twenty-fifth, one fiftieth, or even with one hundredth part of their volume of rectified spirit of wine, that its presence could readily be detected by this test, and I have no doubt but that it is capable of detecting much smaller proportions of that substance should it be present as an adulterant in different essential oils.

I should observe that, where the oil from its density will not rise readily to the surface of the water after agitation, as occurs with a few of the volatile oils, this difficulty I have found may be readily overcome by adding to the contents of the tube a little sulphate of magnesia, which, dissolving in the water and increasing its density, will, if employed in sufficient quantity, cause the oil to rise to the surface, leaving the watery portion below clear and suitable for testing with the molybdic solution.

Before concluding I should also remark that the oils themselves must not be added directly to the test solution, for I find that many of them when so treated, after passing rapidly through various shades, develop a deep blue even though they are apparently pure, and those that do not produce that color give rise to such dark shades, of brown, olive, or black, as to mask more or less completely any blue coloration which might be caused by admixture with alcohol as already described.

The same I found to be the case to a great extent, though acting more slowly, when the test solution in a capsule was placed under a small bell glass and exposed for some time to the vapor of different essential oils emanating from cotton wadding on which they had been dropped, or from a little vessel containing them. In some few instances, however, by using the test in this way, it enabled me to distinguish very quickly the pure oil from the same kind which had been mixed with a minute quantity of alcohol, and it may, therefore, in some cases be of use in detecting such adulteration, or at least in distinguishing differences in various samples of the same description of oil; but I found that this way of employing the test, though much simpler, was not so generally applicable, nor so trustworthy in its indications, as the method already described.—*The Pharmaceutical Journal.*

* The following were the essential oils experimented on; otto of roses, rose geranium, neroli, neroli petitgrain, santal wood, rhodium, patchouly, bergamot, verbena, lavender, rosemary, cinnamon, bitter almonds, lemon, bitter orange, cloves, caraway, peppermint, nutmeg, mustard, anise, fennel, cajuput, cubebs, juniper, turpentine.

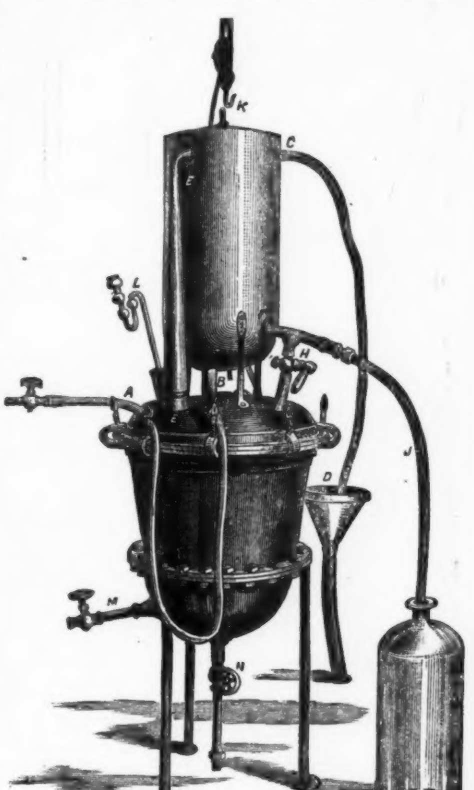
IMPROVED CONDENSER.

By CHARLES RICE.

THE stills which are used by pharmaceutists or chemists are usually provided with a head terminating in a tapering pipe, which is intended to be connected to the worm or condenser. This connection, however, is, in many cases, quite awkward, and often a source of loss from leakage. Those who have had much occasion to work with such an apparatus will fully appreciate the truth of this. In large stationary stills, used on a manufacturing scale, the condenser consists of several parts; the so-called column, a series of vessels, which the vapors have to traverse, and in which all that part of the vapor condensable below a certain temperature is reduced to the liquid condition, and returned to the still; and in addition to this a regular worm or condensing cooler. Such arrangements are, however, too circumstantial for small stills.

To obviate the difficulties above mentioned, the writer has constructed a new form of still-head and condenser, which completely answers all demands made upon it. It requires *one* packing, may be used as a reflux-condenser, and saves a great deal of room, from the fact that a special worm-tub is made unnecessary. The annexed cut gives a very correct representation of the apparatus.

It consists mainly of two parts: the still and the head with condenser. The still has a capacity of sixteen gallons, and is heated by steam, which enters at *M*, *N* being the exhausting pipe. The still-head is constructed of tolerably heavy copper, to be able to bear the weight of the condenser, which is



RICE'S IMPROVED CONDENSER.

fastened to it by three iron legs, attached with rivets. The condenser is a cylindrical copper vessel, of the capacity of about ten gallons, with rounded bottom and closed top, having short half-inch tubes projecting from the bottom and from the top—at *B* and *C*. There are two such tubes at the bottom, one for attaching the rubber-hose *A* bringing the water; the other, shown in the cut immediately alongside the letter B, is closed with a cork, and is used to permit the water to be emptied without detaching the hose from the other. At the top there are likewise two tubes, one at *C*, for attaching rubber-hose to carry off the water into the waste-pipe *D*; the other, being closed with a cork, is not shown in the cut, as it is on the back of the condenser.

The head of the still carries three short tubulures, only one of which is visible in the cut, and which contains a cork bearing the safety-valve, *L*. Another opening is at the other side, for refilling the still when required; and still another narrower tube, intended for the insertion of a thermometer. The condensing-pipe begins at *E*, where it rises from the head parallel with the condenser. It is made of copper as far as the point indicated by the upper *E*, where it is soldered to the *downward projecting* upper end of the block-tin worm contained in the condenser and emerging from it at F. This arrangement makes it impossible for any condensed liquid to come into contact with anything but block-tin. The worm, inside the condenser, is made by carefully winding upon a round block of wood twenty feet of three-quarter inch block tin pipe, taking particular care that the coil has a uniform downward descent throughout. After emerging from the condenser at *F*, it extends for a short distance, where the cut shows it to be connected to the separate block-tin pipe *J* by means of a union joint lined with tin. Half way between *F* and the end proper of the worm, the pipe is tapped and a branch, carrying the faucet *H*, leads into the still *G*, where it terminates under the center of the head in the form of an ⌒, forming a trap to prevent the escape of vapors by this passage. The object of this arrangement is to cause the condensed liquid to flow back into the still as long as the faucet *H* is open, or to collect it outside by turning off the faucet *H*. Prolonged digestions with alcohol may be made by means of this apparatus, without any loss of liquid. The head is attached to the still by means of a rubber washer and iron clamps, and when it is desired to remove it, the water is allowed to drain from the condenser, the clamps are removed, and the whole is hoisted up by the tackle *K* and set on one side.

To illustrate the use of the faucet *H* by an example, we will suppose that we have to completely exhaust 10 lbs. of powdered nux vomica. Into a frame fitting into the upper part of the inside of the still is fitted a broad, short, copper percolator, which is packed with the powdered nux vomica. The head and condenser being connected with the still, about three gallons of alcohol are poured into the still, and the water having been turned on the condenser, and flowing briskly, steam is carefully turned on at *M*. The faucet *H* is kept closed as yet, and the pipe *J* is made to point into a receiver. As soon as condensed alcohol flows into the latter in a steady and uniform stream, the faucet *H* is open, when the flow of alcohol returns to the still, and empties itself from the end of the ⌒ over the center of the percolator. From time to time the faucet is closed, and the regularity of the flow is observed, as it empties itself into the receiver. After a certain lapse of time, depending upon various circumstances, and mainly upon previous experience—in the present instance, after about 4 hours—the nux vomica is completely exhausted, and the last part of the operation consists in turning off the faucet, and permitting all the alcohol to run into the receiver.

The writer is in the habit, when using the apparatus for such purposes, to place into the still two gallons of ordinary glycerine, and into this a large porcelain pot, supported in such a manner that the glycerine surrounds it on all sides up to within about four inches of the top. The liquid to be distilled, such as alcohol, is placed into the dish, the distillate, if required to be used as a continuous menstruum, is made to run back into the still, where it flows into the dish, and finally, after distilling off the alcohol, the dish is removed with the extract contained in it. If the tincture is allowed to run directly into the still, and the alcohol is distilled off, it requires considerable labor and waste of alcohol to remove the extract, besides incurring the danger of overheating and almost baking it.

In all cases, when possible, it is recommended to place into the still a preliminary charge of water, say one-half to one gallon, and to distill this over to dryness. The packing thereby swells up and becomes tight, so that when the alcoholic liquid is introduced no loss will be incurred.

The apparatus is *not* patented, and the writer places it at the disposal of any one who wants to use it.—*New Remedies.*

FLAMES CHARGED WITH SALINE DUST.

M. GOUY.

FLAMES produced by a detonating mixture of coal-gas and of air charged with saline dust are distinguished by several characteristics from the colored flames ordinarily observed in spectral analysis. (1.) Certain salts, such as copper and calcium chlorides, etc., which commonly give rays proper to the undecomposed salt, show here nothing similar and are entirely dissociated; thus calcium nitrate and chloride and copper nitrate and chloride give respectively the same spectrum. In case of the latter metal the spectrum of the chloride reappears if the flame is charged with hydrochloric acid, or if it is cooled by any means soever. Thus the reducing flame burning in a current of coal-gas is surrounded with a blue envelope, which shows the bands of the chloride; in like manner, if the flame contains a large excess of air, its point is colored a pure blue, and gives exclusively the spectrum of the chloride. A cold—as, *e.g.*, a glass rod—if introduced into the flame, is surrounded with a blue halo which displays the bands of the chloride. If this spectrum is seen when operating in the ordinary manner, it is due to the cooling produced by the platinum wire. Strontium, and especially barium chloride, are not entirely dissociated under similar circumstances. The same method is suitable for the study of the spectra produced by oxidizing or reducing flames. It is merely requisite to charge the mixture with an excess of air, or to cause the reducing flame to burn in a current of coal-gas. The detonating mixture is made perfectly homogeneous by causing it to pass through a receiver containing 15 litres. We observe, then, that the spectra of the metals do not disappear suddenly at a certain composition of the gaseous mixture, but become gradually weaker as the excess of air augments. Thus the quantity of the metal which remains free is a continued function of the excess of oxygen in the flame—a function very different for different metals. It is the same with the oxides, at least with the oxide of copper, the only one which gives a beautiful spectrum, and is easily adapted to these experiments. With an excess of air it gives a green flame, whose spectrum is well known. The flame on being rendered reductive turns reddish; it still shows the same spectrum, but the red bands predominate. Whatever may be the cause of this remarkable change, there is no doubt of the existence of oxide of copper in vapor in this flame, which reduces solid oxide of copper. It has been established by M. H. Sainte Claire Deville that such flames contain free oxygen. These observations show the necessity of operating with flames homogeneous and not cooled in order to obtain definite results which may be of some value in sidereal spectroscopy. We see, for instance, that the absence of the rays of the chlorides in the solar spectrum is not the necessary proof of an excessive temperature. (2.) The author has shown (*Comptes Rendus*, lxxxiv., p. 23.) that the surface of the interior cone which forms the base of every homogeneous flame possesses a peculiar emissive power when the detonating mixture holds in suspension saline dust, and gives the same rays as the induction-spark striking upon a solution of the same salt: to the list of metals which display this phenomenon may be added sodium, tin, bismuth, chrome, and osmium. He has studied in detail the structure and the variations of this surface, regulating the flame in such a manner that the height of the cone might differ little from the diameter of its base. When the detonating mixture does not hold saline dust in suspension, the surface of the cone gives merely the rays of carbon, and, if the composition of the mixture varies, undergoes great variations of color, which are generally described in a manner not very exact. When the flame contains neither an excess of air nor of gas, and is at its maximum temperature, the surface is blue; with an excess of air it becomes violet, and its spectrum is almost continuous. With an excess of gas it is at first green, then blue, and less brilliant; this is generally the case with the Bunsen lamp. At the same time it grows dull, its margins become indistinct, and when the flame grows bright at the point it is entirely effaced. A very fine metal wire, supported upon a stronger wire, and introduced into the interior cone, enables us to observe the distribution of temperature there. We see that when the flame has not a great excess of gas the temperature seems to augment abruptly on the surface of the cone. With a large excess of gas the wire becomes red-hot at a distance of 1 m.m. and more from the surface. Hence if we place in suspension in the combustible mixture pulverized cupric chloride, the salt is volatilized before reaching the surface of the cone, throws out rays for a moment, and is then dissociated as the temperature i-

creases. We see then appear a blue surface, equidistant from the former, and between the two a dark space. The new surface is more brilliant than the other, and shows the bands of the chloride; the dark interval may exceed 1 m.m., and diminishes simultaneously with the increase of the gas. With the acetate of copper the surface of the cone becomes rose-colored, the flame being somewhat reddish. Beneath it is a slender green layer, which appears due to the cupric oxide volatilized in the mixture very hot, but not combined. As for the rose-colored surface, it has the color which the oxide of copper takes in a reducing flame. With a great number of other salts, as those of lime, strontia, etc., the surface of the cone, if the gas is in excess, loses its peculiar color and takes that of the flame, upon which it forms a light pattern. It is the same with salts such as chloride of cobalt, which gives a white flame full of very small solid particles. The author has given a great lustre to the spectrum of the inner cone by placing twenty small flames in a straight line in the axis of the collimator of the spectroscope. In this manner he has examined the spectrum of platinum chloride. This salt gives at the base of the flame a spectrum of bands not seen when operating in the common manner, and which the spark does not show. This spectrum is formed of sixteen bands, grouped two and two like those of copper chloride, but larger and more remote from each other. Their right margin (on the violet side) is very distinct, and they fade away on the right. Some of them are furrowed with equidistant black rays. We see, also, some fainter nebulous rays in groups of two or three. This spectrum extends from the red to the violet. Some bands, not the strongest, are still visible above the inner cone. This spectrum is due to platinous chloride, which, according to MM. Troost and Hautefeuille, is re-formed at an elevated temperature. All these observations agree in indicating the existence, at the base of the flame, of a very thin stratum where the temperature is much higher than in the flame itself—a result which theory renders probable.—*Comptes Rendus.*

NEW ORGANIC ACID OCCURRING IN NATURE.

C. Stahlschmidt.

The acid in question, the polyphoric, occurs in certain fungi of the family *Polyporus*, growing on the stems of diseased or dead oaks. The empirical formula is $C_9H_7O_2$. This acid has a yellow color, and is so completely insoluble in water that the slightest trace of a soluble polyporate in water renders the liquid turbid on the addition of salt or of soluble sulphuric acid. In virtue of this property the soluble polyporates may serve as indicators in alkalimetry, the turbidity serving instead of the usual change of color. With all bases it forms well-defined salts, of which the soluble ones, those of the alkalies and ammonia, form deep purple solutions. On heating polyporate of potassium to redness in a combustion-tube along with zinc-powder, benzol was obtained, which was identified by its conversion into nitrobenzol and thence into aniline.

RESEARCHES ON THE GASES CONTAINED IN THE TISSUES OF FRUITS.

M. A. Livache.

In sound fruits contained in the tissues are formed of a mixture of oxygen and nitrogen in the same proportions as in the atmosphere. If the tissues are lacerated the oxygen is rapidly transformed into carbonic acid. If such fruits are left for some time a true fermentation sets in, and there is a plentiful evolution of carbonic acid, whilst the nitrogen undergoes no change.

The juice of the sugar cane, according, to Arno Behr, contains aconitic acid, which was obtained from the preserved juice and from crude sugar, from the latter to the amount of 0·149 per cent. Some Cuban sugars separated from their aqueous solutions minute crystals of aconitate of calcium. Pure aconitic acid, obtained from this source and from citric acid, was found to fuse at 187 to 188° C.; the lower fusing point usually given is due to impurities.

The author found also oxalic acid in the precipitate, obtained by dissolving crude sugar in little water, and mixing the solution with alcohol. *Ber. d. Chem. Ges.*, 1877.

Carbonic Acid in "Ground Air."—Dr. Port.—Determinations of carbonic acid in the ground air were made at Munich at depths of 1·5 to 3·0 metres. It appears that the greatest amount of carbonic acid was generally observed in the autumn. In most of the stations the proportion of carbonic acid was greater in 1873 than in 1874. In some stations there was more carbonic acid found at the depth of 1·5 than at that of 3 metres, but in most instances the proportion was reversed. The proportion of carbonic acid in the ground air gives a useful measure of the degree of pollution of the soil.

EXTRACTION OF COPPER BY AN ACID SOLUTION OF FERROUS CHLORIDE.

M. A. Hauch.

To diminish the quantity of hydrochloric acid consumed in the extraction of copper from malachite, the author uses the acid solution of ferrous chloride obtained in precipitating copper from its hydrochloric solution by means of iron, as resulting from former operations.—*Oesterreich Zeitschrift fur Berg. und Huttenwesen.*

Proportion of Carbonic Acid in the Atmosphere.—Prof. Franz Farsky.—As the mean of 295 determinations the author gives the proportion of carbonic acid as 3·43 vols. in 10,000 of air. This figure is lower than those found by De Saussure and J. Boussingault, but higher than the results obtained by Schultze, Henneberg, Fittbogen, and Hässelbarth. The most numerous fluctuations were observed in November, December, February, March, and April, and the fewest in October. All meteorological conditions were registered along with each observation.—*Biedermann's Central-Blatt.*

Soluble Glass from Infusorial Earth.—F. Capitaine.—The author recommends infusorial earth, very plentiful in North Germany, as suitable for yielding silicate of soda, by treatment with a caustic lye at sp. gr. 1·2, under a pressure of three atmospheres. The soluble glass thus obtained is much richer in silica than that made from flints.

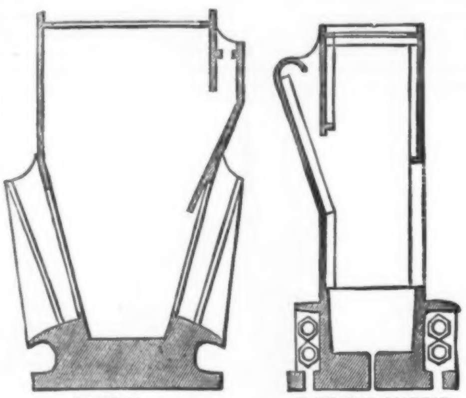
New Method of Transforming Camphor into Camphen.—M. J. de Montgolfier.—The camphor after fusion is treated with sodium at a gentle heat.

CALIFORNIAN STAMPS.

The Cornish stamps are those described and shown in the pages of Agricola nearly 300 years ago, excepting perhaps the stems, which in some instances are now of bar-iron, square in section. The practice of Californian mill men is to erect heavy stamp heads, working at a high speed, with a short drop. It is alleged that such heads will reduce more stuff than an equivalent amount of power expanded in running high stamp heads, at a low speed and high drop. Six heads in a mortar or kover are preferred to three, the number usually included in a Cornish kover. The weight of a heavy head may be taken at 700 lbs.; medium drop of head, 10 in.; number of drops per minute for high speed, 90.

MORTARS.

Mortars are constructed so as to be adapted to the peculiar conditions of their use. The mortar for dry crushing is suitable for either gold or silver ore, while with wet crushing the gold mortar differs from that used for silver. When machinery is to be transported to locations which are inaccessible to wagons the mortars are made in sections, and fastened together permanently when they are put in their place.



MORTAR. SECTIONAL MORTAR.

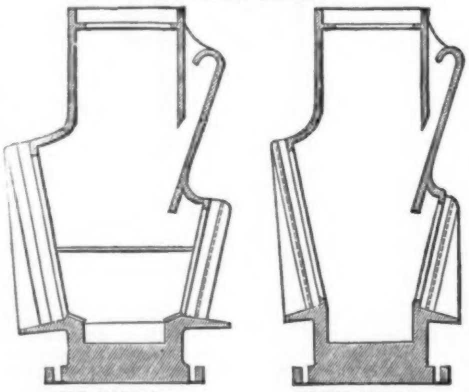
DRY MORTARS.

The dry mortar is illustrated in the accompanying cut, together with the "sectional mortar." In this pattern of mortar the die is set high, as in the wet mortar for gold. The screens are more inclined from the perpendicular than those of wet mortars, and there is a double discharge. The width of the bottom upon which the die is set is about 11 in. for a die 8 in. diameter, while the outside length is about 52 in.

SECTIONAL MORTARS.

In the sectional mortar the upper part is made of boiler plate, fastened at the corners by angle iron. The bed is of cast iron, in sections, cut transversely. A bar of wrought iron is fitted into a groove planed in the bottom, with rivets holding it securely to the sections. This prevents any working of the sections sideways. The sections are firmly bolted together by strong bolts, turned to size, and driven after a reamer. This mortar when set up is very stiff and enduring.

WET CRUSHING MORTARS.



COLD MORTAR. SILVER MORTAR.

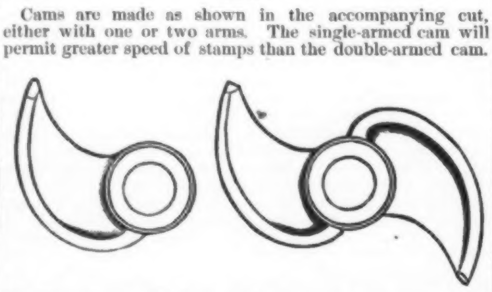
WET CRUSHING MORTARS, GOLD AND SILVER.

The mortar for gold, used with wet crushing, is adapted to be lined with copper plate. The screen doors are also lined with copper, and the discharge is above the lining.

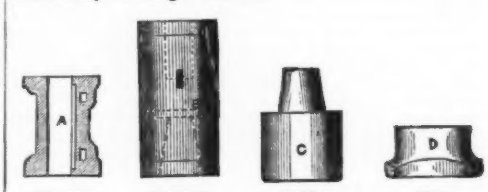
The general shape of the silver mortar for wet crushing is almost identically the same as the gold mortar. The die, however, sets lower, while the screens for which openings are made on each side are brought nearer to the middle line of the stamp, and have their whole surface available for discharge.

CAMS.

Cams are made as shown in the accompanying cut, either with one or two arms. The single-armed cam will permit greater speed of stamps than the double-armed cam.



It will work up as high as 110 drops per minute. The majority of mills use double-armed cams, in order to avoid friction of the cap shaft, since they give two drops of the stem to every revolution of the shaft. The proper curve of the cam is a modified involute of a circle, the radius of which is equal to the horizontal distance between the center of the cam shaft and the center of the stamp stem. The modification of this curve consists in giving a sharper curvature than the involute near the end. This form of cam takes the weight of the stamp at the least practicable distance from the center of the camp shaft, where the lifting motion is slow and the concussion comparatively slight, and leaves it in such a way, on account of the quickened curve, so that the point of the cam shall not tear along the face of the tappet from a line through its center to the outer edge or point of delivery. The outer end is shaped to conform to the edge of the tappet. It is proper to remark here, since the curve of the cam is determined by the distance between the centers of the cam shaft and the stem, that in the erection of the machinery this distance should be strictly adhered to, in order to insure the satisfactory working of the cam.



TAPPET. SOCKET. SHOE. DIE.

TAPPETS.

The tappet, or lifter as it is sometimes called, is secured upon the upper part of the stem, and forms a projection 2¼ in. wide, under which the cam catches and lifts the stamp. In the annexed cut, A is a vertical section of the tappet. It is made of cast iron, and weighs from 60 to 70 lbs. It is alike at both ends, so that when one face becomes worn it can be reversed upon the stem. Formerly the tappets were attached to the stems by means of screw threads cut upon the latter, the tappet being screwed down as a nut upon a bolt; afterward key seats were cut, to receive the transverse key, but these methods have been superseded by a much more simple and convenient device of a wrought-iron gib, set up against the stem by keys, which has received the name of "gib tappet." The tappet is cast with a rectangular recess in one side of the hole for the stem. Into this recess a "gib" is placed. This is a rectangular block of wrought iron, flat on one side, but hollowed on the other, so as to fit the curvature of the stem. Two transverse slots, or openings, at the back of the recess, are provided for keys or wedges, by which the "gib" is wedged tightly against the stem, so that the tappet is firmly secured at any desired angle. Thus no key seat or change of the form of the stem is required, and the tappet can at any time be removed without difficulty, merely by driving out the keys.

SOCKETS.

The stamp head or socket is cylindrical, and made of the toughest cast iron, sometimes strengthened with wrought-iron bands at the top and bottom, shrunk on while hot. It is cast with two central openings or sockets, one in each end, the upper one being for the reception of the tapered end of the stem, and the lower and larger opening for the shank of the shoe. Transverse rectangular openings, or keyways, are made through the socket at the bottom of each end opening. These are for the purpose of driving out the shoe or of detaching the socket from the stem by inserting steel keys or wedges, which bear against the end of the stem or of the shoe, and when driven in separate the one from the other. With proper care the socket wears for years, and after being once attached to the stem need not be removed, but the shoe wears out in a few weeks.

SHOES AND DIES.

The form of the shoe is shown by C and the die by D. Both are cylindrical, and are cast of the hardest and toughest white iron. The shoes are usually 8 in. in diameter and 6 in. in height from the face to the shank. The dies correspond in diameter at the face, but they are often made with a broader face than the shoe. Their base is either a rectangular flange with the corners taken off, or it is round throughout its whole length, and seated into a socket in the bottom of the mortar. The different parts of the stamp are generally disconnected when shipped, since their construction permits of their being united with ease when they are to be placed in the battery. In order to fasten on the tappet it is only necessary to slip it on the stem, and then wedge it fast by means of the gib and keys. To attach the stamp head to the stem the socket is placed upon the die in the mortar, and the stem is dropped into it. A few blows of a hammer upon the upper end of the stem will wedge it firmly into the socket, and it is made lighter by allowing it to drop, socket and all, upon the die. This is regarded as a permanent connection, but with the shoe the case is different, and to render it less difficult to remove this part when worn out, the shank before being inserted into the socket is covered with strips of pine about ½ in. thick. These are held in place by a string while the shoe is placed in its proper position upon the die, and the stamp head is allowed to fall upon it. It thus becomes tightly wedged in the socket, and may be raised with it. After dropping a few times upon the die (protected by a bit of plank) it is driven "home," but there must be a little space left between the top of the shoe and the lower surface of the socket. A stamp thus put together with a 3-in. stem and a 200-lbs. socket will weigh about 620 lbs., the tappet weighing 70 lbs. and the shoe 95 lbs.

CAM SHAFT.

The cam shaft is usually made 4½ in. in diameter for five stamps, and sometimes 5 in. diameter for running ten stamps, with a bearing at each battery post. The pulley on its end is made of wood, built on flanges. The cams are keyed on by either one or two keys each.

GUIDES.

The guides in which the stamp stem is run are generally made of the finest wood that can well be obtained, and they are secured to the girts of the battery frame by means of collar bolts between each two stems. They are constructed in halves, so that when worn by the stem they may be closed up to it by dressing down their faces.

THE SCREEN.

The screen for working ores by the wet process is made generally of Russian sheet iron. This iron has a planished, glossy, and smooth surface; it should be free from rust or flaws, and be very soft and tough. The severest test of sheet iron consists in hammering a part of the sheet into a concave

form. In the manufacture of this kind of screen the sheet is perforated by punches, varying in size from the number 0 to the number 10 common sewing needle. The screen for the working of ores dry is usually made of wire, and varies in fineness from 900 to 10,000 meshes to the square inch.—*Mining Journal.*

RECOVERY OF GOLD FROM SOLUTIONS.

AN easy method to recover gold from solutions, particularly from old toning baths of photographers, has been made known by Fr. Haugk. It consists in filtering the solution into a white glass flask or bottle, making it alkaline with sodium bicarbonate, and then adding, drop by drop, a concentrated alcoholic solution of aniline red (fuchsine), until the liquid retains a deep strawberry color. The flask is then exposed to the sunlight for 6 or 8 hours, at the end of which all the gold still present will have been precipitated as a dark violet powder, and the liquid will have become colorless. After pouring off the liquid, the flask, with its precipitate, is kept until a fresh quantity of solution has to be precipitated, and this is continued until the deposit in the flask is sufficiently large to make it worth while to remove it. It is then transferred to a filter, washed, dried, and burned with the filter. The residue containing the filter-ash is dissolved at a gentle heat in aqua regia, filtered, and the solution evaporated to dryness. The quantity of impurity caused by the simultaneous solution of the filter-ash is too insignificant to be objected to.—*Pharm. Centralh.* fr. *Phot. Arch.*

MINERAL GROWTH.

MR T. A. READWIN, F. G. S., has himself observed lead-vegetation in a Devonshire mine which had been closed, says the *Mining Journal*, not more than half a century previously. He has specimens of cuprite from Redruth showing copper growths while in his possession; he has a piece of Konigsberg argentite which has shown active and excellent silver growth since February, 1876; the grown off portions, so to speak, have themselves increased very much in bulk since January last, and now equal in bulk the argentite from which they had their origin. The general alteration of the surface of the gold globules on Merioneth auriferous quartz since 1856. A rock specimen in his possession has shown gold growth since July, 1875. Curiously jagged, spongoid, dirty chalcedonic quartz, coated nearly all over with yellowish gossan in 1865, shows 25 recent electrum growths. Mr. Readwin remarks that argentine growths are not at all scarce at the British Museum and elsewhere, and he adds that he brought home a few charming specimens of Konigsberg recent silver growth from argentite, in which he has detected some most interesting changes since they have come into his possession.

PAPER NEGATIVES.

THE important progress which has been made of late in emulsion processes goes hand in hand with M. Warnerke's sensitive paper films. Of the latter process we have already placed details before our readers. The emulsion is the same as that ordinarily used upon glass plates, but some not un important improvements have been made in the material by the use of papyroxyl. Instead of the chalk paper previously used by Warnerke, a strongly sized paper is substituted as basis for the collodion; for this reason the film negative will not have both sides glazed as formerly, but one will be matt, a detail, however, which will have no influence upon the negative itself.

The paper, as our readers are aware, is alternately covered with rubber solution and collodion several times, and finally coated with bromide of silver, collodion, or emulsion. This sensitized paper is cut to the proper size to go in the dark slide, and pieces are laid upon one another, each with a sheet of orange paper between, and the whole packet enveloped in tin-foil, so as to keep good for some time.

Practical arrangements for changing sensitized paper out of doors, without a dark tent, were invented twenty years ago; the light metal frame with card-board back, upon which the paper was fastened, was one of these arrangements. Over the frame was slipped a cardboard envelope, and the whole put into the dark slide, which was provided with a slit in the side. The dark slide was adjusted, the cardboard envelope drawn out, the lens was uncapped, the envelope again pushed into the slit, and the time of exposure noted, etc. As the frames were light and unbreakable, and required no care in packing, like glass plates, a large number of them, filled with sensitive paper, could be taken about by a photographer. Other, and perhaps better, arrangements could no doubt be suggested. The old arrangement of the Sutton panoramic camera, which had two rollers for unrolling and rolling up of the paper as exposed, would answer; at any rate, I myself have for the past fifteen years employed the system with waxed paper, and found it exceedingly convenient. If there is a dark room handy, the first of the sheets in the tin-foil case is replaced in the dark slide, taking care that the spring of the latter is not too strong, and does not act so as to bend the packets. The films, as exposed, are put away between yellow paper. Those who prefer to expose the sensitized paper through a glass plate must alter their camera after focussing to the breadth of the plate, so that their picture may be rendered perfectly sharp.

The time of exposure depends, of course, upon the nature of the emulsion that you employ. This material may be produced of a very sensitive nature, but then its development is more difficult; for this reason, it is well at present to employ an emulsion of no very great sensitiveness, which may be developed with certainty. In a good light, to take a landscape view with a rectilinear lens, and full aperture, some twenty to thirty seconds are necessary, and you do well to give rather more, than less, exposure, as a plate which has been over-exposed can be treated successfully with a modified developer, but not so one that has been under-exposed.

The collodion film, whether exposed or unexposed, must be handled with extreme care and with clean fingers, for a hot or dirty hand leaves marks behind it. Before development, a pin is put under the film to disengage a corner, and then the whole sheet may be pulled off with forefinger and thumb, leaving the yellow paper underneath uninjured. Then upon a glass plate, the same size as the film, you put the latter, having previously moistened the glass with water; you press down the film with filter paper, and so make it lie perfectly smooth and even.

The film is now covered with a mixture of—

Benzole	1 part.
Alcohol	10 parts.

This is allowed to remain upon the collodion for a couple of minutes in order to soften it, and to prevent the india rubber from forming spots or patches.

After this film has been exposed and brought back to the laboratory, the development may be conducted in various ways; that is to say, Colonel Stuart Wortley's strong alkaline development may be employed, a weak alkaline solution, iron, or acid pyrogallic solution and silver.

The strong alkaline developer, according to Stuart Wortley's formula, is as follows:

P.—Pyrogallic acid	10 grammes.
Alcohol	50 "
A.—Carbonate of ammonia	10 "
Distilled water	80 "

In this case the ammonia is pounded in a mortar, and mixed with the warm water.

B.—Bromide of potassium	10 grammes.
Water	160 "

Of these solutions, there is mixed in a glass measure:

P	1 gramme.
A	12 "
B	1 "

The film is first rinsed with water until it is no longer greasy, and then this mixture is poured upon it. The image at once appears, but when necessary, half as much again of P, A, and B is added. For larger plates, of course, a larger quantity of mixture must be taken. Should the image appear immediately, it is a proof that the film has been too long exposed, and then another gramme of B must be added. Little glass measures are exceedingly useful in undertaking alkaline development, as in this way one easily accustoms oneself to work with particular quantities.

The weak alkaline developer differs in some degree from that which we have just mentioned, and it should be used for treating the most sensitive films:

A.—Carbonate of soda	10 grammes.
Bromide of potassium	10 "
Water	200 "

Or, instead of the bromide of potassium, half as much bromide of ammonium may be employed.

P.—Pyrogallic acid	10 grammes.
Alcohol	80 "

In applying this developer, you add to twenty-four grammes of water one gramme of P, mix well together, and pour it over the film. The image then appears in all its details. Upon this, the liquid is poured back into the measure, a few drops of it are added, and the image therewith intensified. Or, if preferred, you may pour A over the film first of all, and then add a few drops of P, and, after a few minutes, one or two drops more, when the image increases in intensity.

The iron developer is managed by preparing, in the first place, two solutions they are:

A.—Boiled water	64 grammes.
Citric acid	1 "
Nitrate of silver	2 "
Copper vitriol (sulphate of copper)	8 "

The copper salt is dissolved by itself, and then the silver and acid, having been likewise dissolved, are added. If prepared with boiling water, the developer will hold good a long time.

B.—Sulphate of iron	3 grammes.
Glacial acetic acid	3 "
Water	100 "

Or

Sulphate of iron	5 grammes.
Water	100 "
Methylated spirits	5 "

The film is first moistened with water, and then covered with A; this is then poured back into the developing glass, and then a few drops of B are added. The mixture is applied again and again, until all the details come out.

The acid, pyrogallic, and silver developer is undertaken also with two solutions made up as follows:

A.—Boiled water	64 grammes.
Citric acid	1 "
Nitrate of silver	2 "
Copper vitriol	8 "

The copper salt in this case is also dissolved separately.

P.—Pyrogallic acid	10 grammes
Alcohol	80 "

One gramme of P is put into the glass measure, and twelve grammes of water added to it, and the mixture is then applied to the film, until all the details of the image are developed. Then the solution is poured back into the glass, and a few drops of A are added. With this the negatives may be properly intensified. You may proceed also in the reverse order by pouring some of A solution over the film first, and then adding some drops of P.

The fixing of the film is undertaken in the usual manner, either with a two per cent. solution of cyanide of potassium, or an eight per cent. solution of hyposulphite of soda. The process of intensifying may be resumed after fixing, if necessary, as in the case of ordinary wet collodion plates. The film may be intensified by means of Col. Stuart Wortley's process, the following three solutions being made use of:

C.—Citric acid	1 gramme.
Water	120 "
S.—Nitrate of silver	3 "
Nitric acid	1 "
Water	100 "
P.—Pyrogallic acid	10 "
Alcohol	80 "

A sufficient quantity of C is poured several times over the well washed image, and then for every six parts of C there is added one part of S and P. This mixture will intensify with considerable rapidity, but it is necessary to wash well subsequently, to remove every trace of pyrogallic acid. The film after development may be allowed to remain and dry in contact with the glass upon which it has been developed; or it may be removed and dried between sheets of blotting paper. You may also, as M. Warnerke's has shown, allow the film during development to remain upon the paper. To do this the edges of the paper are bent so as to form a tray, and the film is developed in the same manner as if it were upon glass. Before removal from the paper, the film must be perfectly dry, so that the needle may be pierced into it, and in this manner stripped from the paper.

Applied to the glass the varnishing is necessary, if the film has been much intensified. The varnish employed should be of that kind which dries up transparent without being warmed, and for this reason a benzole or chloroform varnish is to be preferred, as also a spirit varnish, which dries up with a smooth surface.

These paper emulsion negatives are scarcely to be distinguished, when finished, from collodion plates, and the copies furnished are vigorous and brilliant. Before printing, the film is made to adhere firmly to a glass plate by the aid of a little water and an india rubber squeegee. That the films may be printed as well from one side as from another is simply a matter of course. This is a great advantage to the photographer, and one that is especially useful to him if he desires to produce carbon prints by simple transfer, or to utilize the Lichtdruck process. Other advantages of the process are obviously the circumstance that, during the preparation and exposure of the film, no glass plates are necessary, while the films can be preserved afterwards with much greater facility. An artistic illustration prepared by the process will appear in the *Archiv* so soon as the weather will permit of its execution.

Instead of emulsion collodion, bromide of silver gelatine may be employed for coating paper. This gelatine has most extraordinary sensitiveness, equal to that of wet plates, and it may therefore be applicable to the taking of portraits in the studio. It is, however, very desirable that photographers should possess a more familiar acquaintance with alkaline development, for it can scarcely be said that the knowledge of its action and of its manipulations are as yet very widespread. In all dry processes, but particularly in the case of emulsion films, alkaline development is very valuable, as, by its means, a much shorter exposure may be given than is the case when an acid developer is employed.

COLORING AND PRESERVING PHOTOGRAPHS.

By JOSEPH A. SCHULTZ, Batavia, New York.

THE photographic print is first pasted or glued upon a frame forming a very shallow box. When so applied the albumen or prepared side stands outward. When the paper is dry, so as to be perfectly stretched, the box is inverted and the albumen side of the photograph is laid flatwise in direct contact with a plate of zinc. A preparation consisting of 20 parts of animal oil and 1 part of acetic acid is now poured into the box, so as to cover the back side of the paper. This operation will reduce the chemical salts which remain in the texture of the paper, and also make the latter clear and transparent. This operation of neutralization will usually take from four to six hours.

When completed, the box is removed from the zinc plate and the oil is poured out, and its place is supplied by a wash consisting of 1 part of spirits of turpentine and 1 part of benzine or naphtha, to wash out the oil and the metallic salts which remain in reduced particles on the surface of the paper. It is to be worked both outside and inside. The photograph is now perfectly transparent. The wash is very volatile, and leaves the photograph in condition for immediate manipulation with the colors.

While the photograph is still attached to the frame a heavy coloring of oil-tint is spread over the whole surface on the back side within the frame. This may be of any color, but preferably flesh tint. After this, and while the picture is still attached to the frame, I apply a backing to the picture, consisting of picture canvas, picture-board, card-board, or other suitable material, which is placed in direct contact with the paint. This completes the process, with the exception of touching up the right side of the picture with live colors, applied thin to produce the desired tinting. After this the picture is cut from the frame or box, and is then ready for framing or mounting in the ordinary manner.

All photographs contain more or less of metallic salts, which sooner or later change their color, and cause them to dim, fade away, and become expressionless.

By the process before described the metallic salts are neutralized, leaving the photograph in condition to receive the oil-colors, and the picture will become as solid and enduring as an oil-painting. It is impervious to water, is not affected by light, and can be washed without trouble.

THE CYANOTYPE PROCESS.

IT is not unusual, as every photographer knows, for a process to remain *perdu* for some years, and then to get made known again with some mystery and circumstance. We see old friends revived in this way from time to time, and, like somebody whom we meet for the first time in a quaintly shaped hat, or a different colored coat than usual, we fail to recognize him at the first moment of our rencontre. But it is only for an instant that the deception holds good, and the well-known features are as apparent as ever as soon as we get on close terms again. The cyanotype process, as Sir John Herschel used to call it, is the latest attempt at "fraudulent enlistment," and the circumstance that we have here to do with a genuine article, and not a spurious one, does not make the deception the less barefaced. The cyanotype process as practised by Sir John Herschel is a very simple affair, and one that is found extremely useful for copying outline sketches or multiplying tracings, instead of using tracing-paper. Sir John Herschel employed it, as does Professor Herschel, of Newcastle, to the present day, for making copies of their calculations of astronomical tables, the characters or figures being produced in white upon a blue ground. The paper, ready prepared for use by draughtsmen or others, is to be purchased in Paris; and also, we believe, in this country, of Messrs. Marion, of Soho Square; but those who desire to make it for themselves can easily do so. Good, smooth paper is treated with

Citrate of iron (or ammonio-citrate)	140 grains.
Red prussiate of potash	120 "

Dissolved together in two fluid ounces of water. The solution can be kept in a glass-stoppered bottle well wrapped up in a dark cloth, or shut up in a dark cupboard, for any length of time. It is applied by means of a brush or tuft of cotton wool, and the surface dried in the dark. The paper is exposed to light under a tracing, being kept flat by glass plates, and the print fixed by washing in clean water for a few minutes. The ink lines of the tracing must be of an opaque black, such as India ink, etc., to prevent the rays of light from passing, and, as a matter of course, the copy will not be sharp unless the paper is kept firmly in contact with the tracing.—*London Times.*

MONOCHROMATIC LIGHT IN PHOTO-MICROSCOPY.

By Captain Abney, R. E., F. R. S.

When using a microscope for photographic purposes, particularly when a high magnifying power is employed, the residual uncorrected achromaticism is often very marked, and a photograph of any object is frequently ill-defined, particularly when the exposure requisite for one part is greatly different to that required for another part, since the exposure given to one may be sufficient to cause the lesser actinic rays to have an effect, whilst on the other only the more actinic rays are really utilized.

There is also always a difficulty in obtaining a true focus, many trial plates often being wasted in obtaining it actinic. When monochromatic light is used, however, this last difficulty vanishes, and, of necessity, there is no danger of want of definition from the inequality of exposure. I am not aware that the method now proposed has ever been adopted by photo-microscopists; at all events, I cannot find any published account of it. I therefore trust that to the readers of the *Photographic News*, it may be novel.

A is a heliostat throwing the sunlight on B, which is a condenser of four feet focus. D is a lens of about twelve inches focus, which takes the place of the collimating lens in any ordinary spectroscopic arrangement. The rays of light, after passing through the condenser B, are focussed on the slit C. The lens D is so arranged that it throws the rays parallel on to the prism, E, (which may be one formed with carbon disulphide). The rays of light, after being dispersed by the prism, are collected by the lens, F, which should be of varying focus according to the power of the microscopic objective. The spectrum so produced should be focussed on the slide G, containing the subject to be photographed, the camera, H, being in the position shown. Should it be feasible to hold the microscope in a horizontal position, there is no difficulty in this, but where the camera has to be in a vertical position, the mirror attached to the stand must be employed.

The higher the power the shorter should be the focal length of F. With a quarter inch power, a focal length of nine inches will be sufficient. The reason of this varying focal length is that the whole of the subject embraced by the objective should be illuminated approximately by the same colored light. For the same reason the slit should be rather widely opened—so wide, indeed, that its breadth should be at least equal to the breadth of subject in the field of the objective. This opening on the slit prevents the light from being absolutely pure, but it is sufficiently so to prevent any appreciable change of focus being required for the rays embraced in the small part of the spectrum employed. A somewhat similar plan for obtaining monocnromatic light may be substituted for the above. The sunlight may be thrown directly in the prism by the heliostat, and the rays brought to a focus on the slide by means of a lens. If this plan be adopted, the impurity of the spectrum varies according to the focal strength of the lens employed, since an image of the sun is formed by such monochromatic rays, and these overlap. Though more complicated, the first plan is considerably preferable where a high power has to be employed. In using this monochromatic light it is essential that the direction of the ray of light employed to illuminate the object should lie in the continuation of the axis of the objective; or, in other words, if the objective were removed, it should strike the centre of the sensitive plate. Failures have occurred in my own practice through not taking this precaution.

With wet plates the best rays to employ are the blue immediately following the green in the spectrum; when the object is seen to be illuminated with the violet, the exposure will be found to be unnecessarily prolonged. With dry bromide plates a greenish blue may replace the blue rays. It may be noted that when working visually with the microscope the use of monochromatic light is a source of comfort, many details, which are only indistinctly seen, being rendered much more perfectly. By shifting the collimating lens in a plane at right angles to the general direction of the rays, a ray of any color that may be required can be caused to illuminate the object; and, for visual observations, this is particularly useful, since some particular color may be more suitable than another. When photographing opaque objects by the light they reflect, the difficulties increase; but when once they are illuminated by the proper light, cast at a proper angle with the axis of the objective, the employment of dry plates renders feasible what would otherwise be impossible when wet plates are used. The same may be said for the substitution of the lime light, or the electric light, for sun light. With the two former it is possible to use wet plates when only moderate magnification is required, but when an amplification is required of five hundred diameters, dry plates or sunlight are essential.

ASSER'S PHOTO-LITHOGRAPHIC PROCESS.*

The Asser process differs from those generally in use principally in regard to the paper employed, which is not sized or gelatined, and, consequently, though bad for transferring, nevertheless is capable of fulfilling a special rôle. Asser employs an unsized paper, which he simply coats with a little starch paste, dries, and floats upon a bichromate bath. It is possible by means of his process to secure prints in greasy ink from portrait-negatives, which exhibited in the half-tones an agreeable grain, and were very similar to Lichtdrucks which have been pulled from grained glass plates. The half-tone is very well reproduced, and it is evident that in certain directions the process will find many applications.

As the process, though an old one, has not recently been referred to, an account of the *modus operandi* may be welcome. You take unsized paper of medium thickness, and of as fine a texture as possible, and apply to the surface of the same, by the aid of a clean sponge, a thin film of starch dissolved in water. After the paper, hung up on a pin, has dried, it is floated, the coated side uppermost, upon a saturated solution of bichromate of potash in distilled water, with which it is at once impregnated; consequently the paper is permitted to float upon the solution but a very short time. It is then hung in the dark to dry, and at the lowest corner is put a tiny piece of bibulous paper to absorb the superfluous liquid.

As soon as the paper has completely dried, it is put into a printing frame, the starch-coated side against the negative, which should be pretty vigorous and clear. After printing for a longer or shorter time, a clear, brown image appears upon an orange-yellow ground. When sufficiently printed, the paper is put, image uppermost, in a water bath, care being taken that no air-bubbles are formed between paper and water.

It is allowed to float on the water (in the dark) until all the bichromate of potash which has not been acted upon by light is dissolved out, and the picture appears clear and of a light brown color; it is then taken out of the water and dried, first of all between leaves of blotting paper, and then in the air. After drying, the picture is put upon a marble slab, made very hot, taking care, however, that the print does not become brown by heating. By undergoing this operation of heating, the chromate salt is endowed with the property of readily attracting the printing ink.

A piece of unsized paper, rather smaller than the picture, is now moistened, flattened upon a piece of patent plate, and the superfluous water removed by the aid of filter paper. Then the image is floated upon its back for a few seconds upon warm water until the water has moistened through the paper and wetted the coating of starch. The image is then taken out of the water and placed upon the sheet of moist paper lying upon the patent plate; in the position the two surfaces are placed in contact, and covered with a dry sheet of sized paper, the latter being rubbed over in all directions by means of a soft cloth, so that the moisture penetrates uniformly, and the whole becomes firmly adherent to the glass plate. The sheet is then taken away, and the image laid bare.

In the meantime a stone is brought, such as lithographers employ, together with printer's ink, and litho. ink which is mixed by means of a little oil varnish. With this ink, applied to a bit of flannel, a roller covered with fine cloth is coated as uniformly as possible; the roller is then carefully and without pressure rolled over the image, which soon becomes black, and rapidly assumes vigor as the rolling goes on, while the whites still remain perfectly white. The picture is then in a position to be transferred to stone; the application of the ink to the image must not be carried too far.

While the paper is yet damp (so that the paste may adhere to the stone), it is laid upon a lithographic stone and passed in this way through the press. If the paper holds too fast to the stone, so that it cannot be detached, a little damping of the paper soon brings this about. The image is then to be seen clear and sharp upon the stone, and the printing of copies can then be proceeded with in ordinary manner in any lithographic workroom.

The paper employed in the process for the transfer, being unsized, is easily penetrable by water. Portions, however, of the paper, where the light has acted upon the bichromate of potash covering it, do not become moistened. These parts of the paper, indeed, when heated, will permit any ink to adhere at once.

Unsized paper upon which is formed a print in bichromate of potash, after being heated and moistened with water, behaves, in a word, exactly in the same manner as a lithographic stone; some portions of it attract the ink, while others repel it. Where the light has acted, there the surface becomes hard, and the ink adheres; whereas the other portions yet absorb water, and in this condition repel the ink.

If the paper is covered on the image surface with starch, the transfer will have more solidity.

* *Photographische Archiv.*

MOONLIGHT.*

By Richard A. Proctor, B.A.

The light of the moon and the changes of the moon were probably the first phenomena which led men to study the motions of the heavenly bodies. In our times, when most men live where artificial illumination is used at night, we can scarcely appreciate the full value of moonlight to men who cannot obtain artificial light. Especially must moonlight have been valuable to the class of men among whom, according to all traditions, the first astronomers appeared. The tiller of the soil might fare tolerably well without artificial light, though even he—as indeed the familiar designation of the harvest moon shows us—finds especial value, sometimes, in moonlight. But to the shepherd moonlight and its changes must have been of extreme importance as he watched his flocks and herds by night. We can understand how carefully he would note the change from the new moon to the time when, throughout the whole night, or at least of the darkest hours, the full moon illuminated the hills and valleys over which his watch extended, and thence to the time when the sickle of the fast waning moon shone but for a short time before the rising of the sun. To him, naturally, the lunar month, and its subdivision the week, would be the chief measures of time. He would observe—or rather he could not help observing—the passage of the moon around the zodiacal band, some twenty moon-breadths wide, which is the lunar roadway among the stars. These would be the first purely astronomical observations made by man; so that we learn without surprise, that before the present division of the zodiac was adopted, the old Chaldæan astronomers (as well as the Indian, Persian, Egyptian and Chinese astronomers, who still follow the practice) divided the zodiac into 28 lunar mansions, each mansion corresponding nearly to one day's motion of the moon among the stars.

It is easy to understand how the first rough observations of moonlight and its changes taught men the true nature of the moon, as an opaque globe circling round the earth, and borrowing her light from the sun. They perceived, first, that the moon was only full when she was opposite the sun, shining at her highest in the south at midnight when the sun was at his lowest beneath the northern horizon. Before the time of full moon, they saw that more or less of the moon's disk was illuminated as he was nearer or farther from the position opposite the sun, the illuminated side being towards the west—that is, towards the sun; while after full moon the same law was perceived in the amount of light, the illuminated side being still towards the sun, that is, towards the east. They could not fail to observe the horned moon sometimes in the day time, with her horns turned directly from the sun, and showing as plainly, by her aspect, whence her light was derived, as does any terrestrial ball lit up either by a lamp or by the sun.

The explanation they gave was the explanation still given by astronomers. Let us briefly consider it. In doing so I propose to modify the ordinary text-book illustration which has always seemed to me ingeniously calculated (with its double set of diversely illuminated moons around the earth) to make a simple subject obscure.

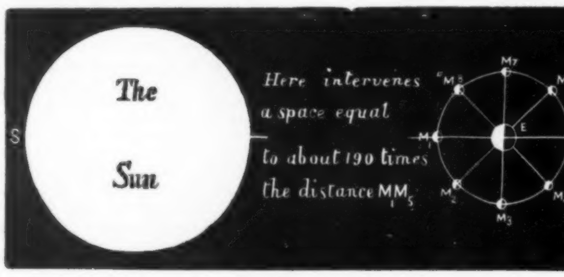
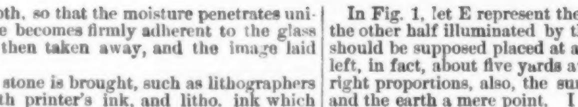


Fig. 1.

In Fig. 1, let E represent the earth one half in darkness, the other half illuminated by the rays of the sun, S, which should be supposed placed at a much greater distance to the left, in fact, about five yards away from E. To preserve the right proportions, also, the sun ought to be much smaller and the earth a mere point. I mention this to prevent the reader from adopting erroneous ideas as to the size of these bodies. In reality it is quite impossible to show, in such figures, the true proportions of the heavenly bodies and their distances. Next let M^1, M^2, M^3, etc., represent the moon in different portions along her circuit around the earth at E.

Now, it is clear that when the moon is at M^1, her illuminated face is turned from the earth, E. She, therefore, cannot be seen, and accordingly, in Fig. 2, she is presented as a black disk at 1 to correspond with her invisibility when she is as at M^1. She passes on to M^2, and now from E a part of her illuminated half can be seen towards the sun which would be towards the right if we imagine an eye at E looking towards M^2. Her appearance then is as shown at 2, Fig. 2. In any intermediate portion between M and M^2, the sickle of light is visible but narrower. We see also that all this time the moon's place on the sky cannot be far from the sun's place, for the line from E to M^2 is not greatly inclined to the line from E to S. When the moon has got around to M^3, the observer on the earth sees as much of the dark half as of the bright half of the moon, the bright half being seen, of course, towards the sun. Thus the moon appears at 3, Fig. 2. Again as to position, the moon is now a quarter of a circuit of the heavens from the sun, for the line from E to M^3 is square to the line from E to S. We see similarly that when at M^4 the moon appears as shown at 4, Fig. 2, for now the observer at E sees as small a part of the moon's dark side as he had seen of her bright side when she was at M^2. When she is at M^5, the observer at E sees her bright face only, the dark face being turned directly from him. She, therefore, appears as at 5, Fig. 2. Also being now exactly opposite the sun, as we see from Fig. 1, she is at her highest when the sun is at his lowest, or midnight; and, at this time, rules the night as the sun rules the day.* As the moon passes on to M^6, a portion of her dark half comes into view, the bright side being now towards the left, as we look at M^5 from E, Fig. 1. Her appearance, therefore, is as shown at 5. When at M^7 she is seen at 7, half bright and half dark, as when she was at M^3, but the halves interchanged. At M^8 she appears as at 8, and, lastly, at M^1 she is again undiscernible.



1 2 3 4 5 6 7 8 9

Fig. 2.

The ancient Chaldæan astronomers could have little doubt as to the validity of this explanation. In fact, while it is the explanation obviously suggested by observed facts, one cannot see how any other could have occurred to them.

But if they had had any doubts for a while, the occurrence of eclipses would soon have removed those doubts. They must early have noticed that at times the full moon became first partly obscured, then either wholly disappeared or changed in color to a deep coppery red, and after a while reappeared. Sometimes the darkening was less complete, so that at the time of greatest darkness a portion of the moon seemed eaten out, though not by a well-defined or black shadow. These phenomena, they would find, occurred only at the time of full moon. And if they were closely observant, they would find that these eclipses of the moon only occurred when the full moon was on or near the great circle round the stellar heavens, which they had learned to be the sun's track. They could hardly fail to infer that these dark-

"* The Day of Rest."

* It has been thought by some that, in the beginning, the moon was always opposite the sun, thus always ruling the night. Milton thus understood the account given in the first book of Genesis. For he says:

Less bright the morn
But opposite in levell'd west was set
His mirror, with full face, borrowing her light
From him; for other light she needed none
In that aspect; and still that distance keeps
Till night, then in the east her turn she shines
Revolv'd on Heav'n's great axle.

It was only as a consequence of Adam's transgression that he conceives the angels sought to punish the human race by altering the movements of the celestial bodies:

To the blank moon
Her office they prescribe—

It is hardly necessary to say, perhaps, that this interpretation is not scientifically admissible.

enings of the moon were caused by the earth's shadow, near which the moon must always pass when she is full, and through which she must sometimes pass more or less fully; in fact, whenever, at the time of full, she is on or near the plane in which the earth travels round the sun. Solar eclipses would probably be observed later. For though a total eclipse of the sun is a much more striking phenomenon than a total eclipse of the moon, yet the latter are far more common. A partial eclipse of the sun may readily pass unnoticed, unless the sun's rays are so mitigated by haze or mist that it is possible to look at his disk without pain. Whenever solar eclipses came to be noted, and we know from the Chaldæan discovery of the great eclipse period, called the *Saros*, that they were observed at least two thousand years before the Christian era, the fact that the moon is an opaque body circling round the earth, and much nearer to the earth than the sun is, must be regarded as demonstrated. Not only would eclipses of the sun be observed to occur only when the moon was passing between the earth and the sun, but in an eclipse of the sun, whether total or partial, the round black body cutting off the sun's light wholly or partially would be seen to have the familiar dimensions of the lunar orb.

Leaving solar and lunar eclipses for description, perhaps, on another occasion, I will now proceed to consider a peculiarity of moonlight which must very early have attracted attention—I mean the phenomenon called the harvest moon.

The moon circuits the heavens in a path but slightly inclined to that of the sun, called the ecliptic, and for our present purpose we may speak of the moon as traveling in the ecliptic. Now we know that during the winter half of the year the sun is south of the equator: the circle of the heavenly sphere which passes through the east and west points of the horizon, and has its plane square to the polar axis of the heavens. During the other or summer half of the year he is north of the equator. In the former case the sun is above the horizon less than half the twenty four hours, day being so much the shorter as the sun is farther south of the equator; whereas in the latter case the sun is above the horizon more than twelve hours, day being so much the longer as the sun is farther north of the equator. Precisely similar changes affect the moon, only, instead of taking place in a year (the time in which the sun circuits the stellar heavens), they occur in what is called a sidereal month, the time in which the moon completes her circuit of the stellar heavens. For about a fortnight the moon is above the horizon longer than she is below the horizon, while during the next fortnight she is below the horizon longer than she is above the horizon. Now, clearly, when the length of what we may call the moon's diurnal path (meaning her path above the horizon) is lengthening most, the time of her rising on successive nights must change least. She comes to the south later and later each successive night by about 50½ minutes, because she is always traveling towards the east at such a rate as to complete one circuit in about four weeks; and losing thus one day in 28, she loses about 50½ minutes per day. If the interval between her rising and arriving to the south were always the same, she would rise 50½ minutes later night after night. But if the interval is lengthening, say by 10 minutes per night, she would of course rise only 40½ minutes later; if the interval is lengthening 20 minutes per night she would rise only 30½ minutes later, and so forth. But the lunar diurnal arc *is* lengthening all the time she is passing from her position farthest south of the equator to her position farther north, just in the same way as the solar day is lengthening from midwinter to midsummer, only to a much greater degree. And as the solar day lengthens fastest at spring when the sun crosses the equator from south to north, so the time the moon is above the horizon lengthens most, day by day, when the moon is crossing the equator from south to north. It lengthens, *then*, from an hour to an hour and 20 minutes in one day, that is the interval between moonrise and moonsetting increases from 30 to 40 minutes. At this time, then, whenever it happens in each lunar month, the moon's time of rising changes least—instead of the moon rising night after night 50½ minutes later, the actual difference varies only from 10 to 20 minutes.

Now when this happens at a time when the moon is not nearly full, it is not specially noticed, because the moon's light is not then specially useful. But if it happens when the moon is nearly full, it is noticed, because her light is then so useful. A moon nearly full, afterwards quite full, and then for a day or two still nearly full, rising night after night at nearly the same time, remaining also night after night longer above the horizon, manifestly serves man for the time being in the most convenient way possible. But it is clear that as the full moon is opposite the sun, and as to fulfill the condition described we have seen that she must be crossing the equator from south to north, the sun, opposite to her, must be at the part of his path where he crosses the equator from north to south. In other words, the time of year must be the autumnal equinox. Thus the moon which comes to "full" nearest to September 22 or 23 will behave in the convenient way described. At this time, moreover, when she rises night after night at nearly the same time, the nights are lengthening the fastest while the time the moon is above the horizon is lengthening still more—and, therefore, in all respects the moon is then doing her best, so to speak, to illuminate the nights. At this season the moon is called the harvest moon, from the assistance she sometimes renders to harvesters.

The moon which is full nearest to September 22–23, may precede or follow that date. In the former case only can it properly be called a harvest moon. In the latter it is sometimes called the hunter's moon. The full moon occurring nearest to harvest time will always partake more or less of the qualities of a full moon occurring at the autumnal equinox, and similarly of a full moon following the autumnal equinox. So that, in almost every year, there may be said to be a harvest moon and a hunter's moon. But, of course, it will very often happen that in any particular agricultural district the harvest has to be gathered in during the wrong half of the lunar month, that is, during the last and first, instead of the second and third quarters.

The reader must not fall into the mistake of supposing, as I have seen sometimes stated in textbooks of astronomy, that we are more favored in this respect than the inhabitants of the southern hemisphere. It is quite true that the same full moon shines on us as on our friends in New Zealand, Australia, and Cape Colony, and also that our autumn is their spring, and their spring our autumn. But the full moon we have in autumn behaves in the southern hemisphere not as with us, but as our spring full moon behaves; and the full moon of our spring, which is their autumn, behaves with them as our autumn moon behaves with us. It is, therefore, for them a harvest moon if it occur before the equinox, and a hunter's moon if it occur after the equinox. A very little consideration will show what this is. In fact if, in the explanation given above, the words north and south be interchanged, and March 21–22 written for September 22–23, the explanation will be precisely that which I should have given respecting the harvest (or March) moon of the southern hemisphere, if I had been writing for southern readers.

THE SATELLITES OF MARS.

THE erroneous statement appeared in several of our papers a few days ago that the discovery of the satellites of Mars had been claimed by a French astronomer. The official report of the French Academy has just been received, from which it appears that M. Borelli of Marseilles claims priority in the discovery of a new *asteroid* observed almost simultaneously by Professor Watson of Michigan. The undisputed claim to this brillant discovery of the satellites rests, therefore, with Professor Hall of Washington. The opinion is general among his brother astronomers that no one has better earned such a reward by long-continued and careful observations.

Professor Hall is now engaged in an elaborate series of measurements of the position of the satellites to determine the form of their orbits. A similar series of measurements is in progress at the Harvard College observatory. The smaller size of the telescope, giving only one-third the light of the Washington instrument, renders this work a matter of no little difficulty. The satellites are so minute that when Mars is in the field they cannot be seen, and when it is out of the field its position cannot be measured. A remedy is found by covering half the field with colored glass, through which Mars is seen, but so dimly as not to render the satellites invisible. The only measurements made elsewhere, so far as heard from, are at the observatory at Paris. On August 27, a week after intelligence had been received of their discovery, M. Henry measured the position of the outer satellite with the Paris telescope, obtaining a result agreeing with those found in this country. No news has been received of other observations of these satellites abroad as yet.

Besides the measurements referred to above, another problem of much greater difficulty has been attacked by the Cambridge telescope,—namely, an accurate measurement of the brightness of these minute bodies. Several methods have been employed to obtain results wholly independent, as, for instance, reducing Mars until it is no brighter than the satellite, or allowing it to shine through a very minute hole and comparing the light. A curious discovery has thus been made regarding the color of the satellites, which do not partake of the red tint of Mars. This could not be determined by ordinary observations, since the intense light of Mars would prejudice the eye. When Mars is out of the field and its image reduced to the brightness of the satellite and brought close to the matter, the difference in color is well shown, Mars appearing red and the satellite gray or bluish like Saturn. The light affords the only measurement which will probably ever be possible of the diameter of these minute bodies, its angular amount being only two or three hundredths of a second of arc.

In other words, the satellites look about as large as a man's fist seen at a distance equal to that from Washington to Boston. If the measures thus described give the diameter within a mile, as they probably will, this is equivalent to the Boston man determining the size of the fist of the Washington man within half an inch!—*Boston Advertiser.*

THE GREAT LICK TELESCOPE.

RICHARD S. FLOYD, one of the trustees of the Lick Trust, has just returned from an extended European tour. During his absence he has talked with many scientific men of this and other countries, but almost invariably found them afraid to commit themselves to an opinion as to whether a greater success can be obtained with a reflecting or with a refracting telescope. Professor Newcomb, of the Observatory at Washington, after his visit to Europe to look into this matter for Mr. Lick, reported warmly in favor of a gigantic refractor, and forwarded estimates as to cost. He has since changed his opinion, however, and now recommends a silver-on glass reflector of about 7 ft. diameter. Rosse's, Herschel's, and other celebrated telescopes have speculum metallic reflectors, which have until lately been considered the best. Now the palm is claimed for an invention of Léon Foucault, by which silver in solution is deposited on glass. Foucault made a reflector upon this system about thirty-one and one-fifth inches in diameter, and excellent work has been accomplished with it. After his death a reflector upon his plan, about 4 ft. in diameter, was constructed for the Observatory. Owing to some not thoroughly explained cause this has not proved a success, and another of the same dimensions is being constructed to replace it. Great interest is manifested in the result of this second experiment, which cannot be proven for a year yet. Dr. Huggins also favors a large reflector, as it is better for spectroscopic analysis, his favorite study. It is natural that he should prefer a reflector, as he desires to have the field of physical astronomy enlarged. Theoretically, a reflector of 4 ft. in diameter is about equal to a reflector of 26 in. The Ross reflector is 6 ft. in diameter, only four of which are effective, and so far it has not been proved that more than 4 ft. of a reflector can be made effective. The great trouble with the reflector is that it is very sensitive to atmospheric changes, while with the refractor the difficulty lies in the secondary spectrum. The object-glass of the refractor is composed of two glasses joined, the outer being of crown glass, the other of flint. Rays passing through the crown glass are refracted. The consequence is that perfect achromatism is impossible, and the difficulty of compensating these refractions increases with the size of the object-glass. The largest refractor in the world is that in the Washington Observatory; it is 26 in. in diameter, and is an excellent instrument. Mr. Floyd said that, after as careful an examination as he could make, he is inclined to believe that the best interests of the fund will be served to have constructed a larger refractor than any yet made. This ought not to cost, complete, more than £30,000. Then there will be a subsidiary refractor, about 4 ft. in diameter, supplied with both silver-on-glass and speculum metal mirrors. Such an instrument has been offered, or rather parties have agreed to construct one, for about £4,000. Feil, of Paris, will undertake to make crown and flint glass discs for the object-glass of a 40 in. refractor for about £4,000—stipulating that he shall be allowed two years for construction.—*San Francisco Bulletin.*

THE ROTATION OF THE SUN.

AT the recent meeting of the British Association, Captain Abney described a method of showing the rotation of the sun by means of spectrum analysis. A condenser is prepared by cutting a lens across the center and mounting the two halves side by side, in such a manner that the two images formed by the sun are tangential one to another, the tangent being parallel to the horizon. The light from the sun is thrown into this condensing arrangement by means of a heliostat having a mirror silvered on the surface; and the images are brought to a focus on the slit of a spectroscope, the point of contact of the two suns occupying a position half-way down the slit. To the spectroscopic apparatus is attached a camera and lens of some 6 or 7 ft. focal length, and the spectrum is thus formed on a sensitive plate. When the north and south points of the sun's image are tangential, evidently no displacement of the two portions of the spectrum formed by the upper and lower halves of the slit should be seen; whereas, when the equatorial portions of images are in contact, the displacement of the lines should be that due to double the rotation, since the eastern limb should be receding and the western advancing. Thus, if photographs were taken in the morning, at noon, and in the evening, the apparatus remaining in the same position, it is evident that a displacement of the lines in the top half of the spectrum should be noted in one direction; next, there should be no displacement of the lines in the top spectrum in the reverse direction to that first noted. On the two separate occasions on which I have devoted a day to this subject I have found such to be the case. In the first I was using a refraction apparatus of considerable power; in the second I employed a diffraction grating by Rutherford, of over 17,000 lines to the inch, which Mr. Lockyer kindly placed at my disposal. The fourth order of the spectrum in the last case was employed, and that portion lying about the H lines was taken to test the method. I have not had sufficient time to measure the displacement of the lines, but as far as I have gone, the truth of the method first employed by Huggins, as applied to the stars, is fully borne out.

INFLUENCES OF THE EARTH'S ROTATION.

THE law deduced by Baer from observation on Russian rivers, regarding influence of the earth's rotation on the form of river banks and beds, has received confirmation by various observers since. The attention has been almost exclusively directed, however, to rivers flowing in meridian direction. And a like remark applies to investigations of the pressure arising from the earth's rotation on one of the rails in railways. In a recent paper to the Vienna Academy, M. Finger enlarges the problem beyond this and other limitations (especially of rivers and winds) in any paths parallel to the *spheroidal* (not *spherical*) surface of the earth. One surprising result is that, even when the azimuth of the direction does not vary, the lateral pressure to the right is not (as the adherents of Baer's law suppose) greatest for a motion along the meridian, nor has it the value indicated by the law for all azimuths, but it depends on the value of the azimuth, and, with conditions otherwise equal, it is greatest for a motion toward the east, and least for a motion toward the west. With regard to vertical pressure of a body moving along the earth's surface, M. Finger finds that, in consequence of the earth's rotation alone, even if the temperature and vapor conditions did not vary, there would be an influence of wind-direction on the state of the barometer, small, indeed, but in the case of strong winds by no means to be neglected, so that a higher barometer would correspond to the east winds, a lower to the west.—*Nature.*

PROFESSOR RUDOLPH in a lengthy paper on the sun, says: "A molten or white hot mass 850,000 miles in diameter, equaling in bulk 1,260,000 worlds like our own, having a surrounding ocean of gas on fire 50,000 miles, volcanic fires that hurl into the solar atmosphere luminous matter to the height of 160,000 miles; drawing to itself all the worlds belonging to our family of planets and holding them all in their proper places; attracting with such superior forces the millions of solid and stray masses that are wandering in the fathomless abyss that they rush helplessly toward him and fall into his fiery embrace.

AMONG the adulterations of magenta the *Teinturier Pratique* enumerates bronze turnings and sugar. The former very clumsy fraud may be at once detected by the insolubility of the fragments in water and alcohol. The latter, which is now rather an old trick, comes to light if we steep the color in absolute alcohol, which dissolves the crystals of magenta, leaving the sugar untouched. Sugar granules may may likewise be recognized under the microscope.

THE SOURCE OF THE GULF STREAM.

By DR. I. E. NAGLE, New Orleans.

SEVERAL years ago I became deeply impressed with the idea that the visible streams which debouch into the Gulf of Mexico, and the evaporation which takes place over the immense area of country lying between the Rocky Mountains and Appalachians, were insufficient to carry away the amount of precipitation which occurs on that vast surface. The evident difference between the hydrographical and hygrometrical condition led me to consider that those regions have numerous invisible outlets to the sea. While wandering over those plains and dreary wilds of deep sands we discover that they absorb vast floods, yet the spongy surfaces remain dry, and parched, as if they were ever void of moisture. In the huge and impenetrable cañons and gorges of those eternal hills, masses of snow and melting glaciers dissolve into cavities and channels, whence there is no egress on the continent.

A certain large amount of water, which runs off the eastern watershed of the Rocky Mountains, finds its way into the channels of the Red River of the North, Platte, Missouri, Arkansas, Rio Grande, Red, Mississippi, and other deporting streams, which partially drain that interminable region of porous, arid earth, basalt crags and silicious plains. Another certain amount is evaporated and finds its way from the humid and condensing atmosphere of deep valleys and cold mountain altitudes, traveling in clouds and falling far eastward in rains and snow. But there is yet a very large proportion of the rain and snow fall which dissolves in that region to be accounted for. Over vast surfaces of those desert plains and sterile sands, there is no evaporation or visible aqueous exit, for such a process would create constant humidity. The actual hygrometric condition of that section is of decided dryness, and in many portions of Kansas, Colorado, New Mexico, etc., the clearest air that mantles earth hovers over that region. In this crystalline brightness the mind is ever deluded with the illusions that the *mirage* presents to our eyes. In some special localities near Pike's Peak, it is more singularly impressive and deceptive than the *looming* which appears in the Western Behring's Sea and the *mirage* which bewilders the view in the high latitudes reached by the late arctic exploring parties. In the clear

and dry atmosphere referred to, the earth seems to absorb all moisture, hence we find that its purity has a desiccating property, which prevents decomposition. The aqueous portions are simply extracted from the animal tissue, leaving the mass dry and inodorous; and being thus relieved from the element necessary to produce fermentation, there is withdrawn all chemical cause of putrefaction and decay.

The Rocky Mountains occupy a vast irregular cavernous and volcanic area. The topographical surface is also very much broken and variegated with fertile valleys, sandy plains, and arid, desert wastes. The detritus from numerous rock-ribbed ranges are scattered over all that region, which lies beneath the dreamy mists and mirror-like glare of that intensely bright atmosphere. Those gaping gulches and unfathomable ravines are eternally changing, though they retain the same outlines as they were left thousands of years ago, when vast ice floes and ponderous glaciers drifted hither from the cold gray sea which covered all the primitive land of Huronian and Laurentian altitudes. Those glacial giants and rugged Titans tore out excavations, and overcame all obstructions as they surged and ground their way, carrying destruction and devastation throughout all the then submerged continent of North America. During their voyages they grasped with their icy fingers and embraced in their huge pockets an incalculable wealth of minerals and fertile components, which by attrition was divided, and finally lavishly scattered on the surfaces over which those huge ships floated, lodged and melted away.

In the immense chasms and basins plowed out by the tide-swept gelid masses, there were left only interminable deposits of deep sands, whose greedy waves, ever insatiate, drink and absorb the fluids which descend from clouds, fogs and storms. The invincible dynamic power of those glaciers excavated to the basalt and granite floors, whereon now lie those inland seas of saline, brackish and mephitic solutions, which excite our surprise and wonder. Those immense reservoirs of salt and bitter liquids, with their eternal sullen depths, their angry, heavy, pulsing waves slowly beating dull monotones in the funeral march of ages, their solitary and forbidding isolation, are confined like mobile giants, away up in rock-bound altitudes, held by restraining barriers and amid desolate fastnesses, where the eagle cares not to harbor. They have too long had the decree pronounced against them by explorers and savans, that they are profitless regions, merely idle curiosities, fruitless ponds, which do not subserve any purpose of utility, not even to relieve the vision, which wearies of the monotony of impenetrable recesses and silent monumental peaks, where no living thing can find access to or habitation.

The uses of these reservoirs is to feed the great currents which run in the ocean. All the drainage of the vast continent of mountain barrens and American deserts have numerous subterranean outlets into those vast seas, which roll their waves on the shores of America. By constant addition of their volumes, these furnish to the Gulf Stream an immense flood, to which the Mississippi River and the heated belt which sweeps around the south side of the Antilles and northward from the Florida Keys are attenuated threads of rain compared to the great bulk of mysterious ocean. By the impulsive force of their own tremendous gravity and constantly increasing power and accession of weight, they sink into the deepest recesses of earth, even to the impermeable rocks which lie many miles from the periphery. But these streams find egress, for that physical law, which makes water seek its level, the irresistible hydraulic pressure of artesian process, weighs it downwards, and urges it ever outward and upward, to find vent and mingle in numberless streams with that great tide which flows unceasingly, but never ebbs in the Atlantic.

Thus the supplies of the Gulf Stream, though they vary greatly in temperature and specific gravity, maintain the special feature of being hot, for they boil and seethe and flow from caldrons and over igneous, rock-ribbed furnaces, where the volcanic fires of earth are never quenched. The quantity of fluids which flows through these subterranean channels can only be estimated by stating that they make up the balance of bulk beyond the visible amount furnished by streams and evaporation. The pressure of altitudes and superimposed weight of immense bodies of fluids force themselves through the greatest obstacles, hence all the seams of earth and every sinuosity that permeates its cavernous crust are filled with water, the quantity of which increases as it descends into the interior; for dig where we may, at all depths we find currents and streams of various sizes.

Some years ago I published an opinion, which subsequent study in the southern seas has fixed in my mind more firmly. This is, that the supply of thermal waters which debouch into the Caribbean Sea and warm coast waves of the Pacific comes from the fire belt recesses, the apparently extinguished furnaces of the Rocky Mountains, Cordilleras of Mexico, and what are called extinct or suppressed volcanic circles of that region.

The fractures, by which those mountains were formed, happened at the most friable and weak points above molten chemical basins and streams, which lie there and in various other portions of earth. The fractures that formed Popocatapetl, Coahuila, and other extinct craters in Mexico are simply cicatrices, which indicate the location of such ancient wounds, inflicted by fire and its consequent ally—earthquake. In those ruptures, by which the Rocky Mountains were made, the surface was cut into many angles, dips and altitudes, which are as visible now as when their violent birth occurred, though they have been denuded of their former height by the wear of uncounted ages and attrition of all manner of chemical and mechanical agencies, during thousands of centuries that have gone into the past, since those rugged crests and mangled faces went groaning up from the lava sodden earth, to accept the smiles of the sun and be cooled by mantles of snow. The broken surfaces of those torn mountains embraced each other again, as they fell back toward their original bases, but only the jagged lips at their crests met. Far beneath these, the jutting jaws and detached teeth of interior rocks, which had been rended apart, were locked into each other's embrace, seldom indenting, and nearly always forming unsymmetrical angles and slopes, which appear on mountains and low outlying hills. Hence throughout mountainous regions there are immense cavernosities, usually irregular, triangular and arched cavities, which always tend from the high altitudes toward the equatorial line. These innumerable veins are superimposed above each other indefinitely, and eternally flowing floods have been rushing, as subterranean rivers through them, during all the ages since mountains were convulsed into shape. Those subtle streams and water courses of all sizes exist at all depths, and traverse every direction far below our tangible and accurately mapped surface currents. In the deep recesses of earth, following the law of artesian pressure and hydraulic gravitation and hydrostatic force, they go irresistibly surging along in their dark and cavernous channels, to finally pour into the insatiate ocean their vast volumes of thermal waters.

From the great salt and fresh water lakes of the Rocky Mountains, their waters sink through unfathomable cañons, and percolate through the sieve-like sands of sodden plains, searching for rest, sinking by their own increasing weight as they go down to the heated primitive rock bases; and over surfaces of those Plutonian barriers, the fire beds of our globe, they go tossing and fuming, where volcanic and intestine heats seethe and fret them into geysers. Driven in huge clouds of steam, they are poured into vast caverns, in whose icy-tempered recesses they are condensed, and in watery volumes again pursue their course unceasingly onward to find freedom beneath the sunlight and swell the heated waters of that interoceanic river—the Gulf Stream. From every minute point and particle of land, and from the depths of illimitable ocean and its land-bound confines, these perpetual streams spring into the steam laden current and swells its resistless tide and thermal stores.

Thus from those far-away mountain slopes and fertile valleys they go on for ever flowing, passing in their courses beneath the rolling muddy flow of the Missouri and Mississippi Rivers; drop far below the grand plains of the Great West; grope in dark and tortuous channels under the great beds of the ancient Silurian sea; creep slowly below the huge Alleghanies; crash through vast rents in the Appalachian range; foam in torrents through deep gorges; dash in spray through illimitable caverns; roar down the precipitous sides of rocky ledges; and rush over falls, in cataracts, to which Niagara is a pigmy. Feebly fluttering beneath broad savannas and marshes by the sea, they finally emerge into the Atlantic and mingle their precious drops with that world of waters, and go singing and flowing forever in the light, wherein primal colors glow in ten thousand glorious tints and shades and hues, which sparkle in every gem-like drop of clouds and prismatic zones beneath the sun.

The Gulf Stream is a little river in the Caribbean and Mexican seas, but as it moves northeastward it swells into the magnitude of a ponderous moving current in the sea, and girdles with a hot belt the shores of a vast continent. Into this, there is poured from unfailing sources, the *débris* which those subterranean carriers bring from the surface beds and rich depths of far-off western valleys, northern prairies and southern plains. These the mysterious river of ocean takes into its loving warm embrace and deposits them on the coasts of Newfoundland and the English Isles. But it is not altogether to the Gulf Stream that these sources of fertilization and warmth contribute their vast stores. Restless forces of ocean are ever wearing away its bed, by the resistless power of attrition and dredging, from which processes the earth's armor above its various beds of molten lava becomes thinner, and those waters which cover them are freed by the repellent power of their own steam, to swell the tide and volumes of hot ocean currents. Such is doubtless the condition of the bottom of the Gulf of Mexico and Caribbean Sea, which were formed by a vast cataclysm, produced by volcanic power. When the latter expended its force, the earth, which then occupied that place now covered by these waters, subsided into their present depths. But those fires are not extinct, for earthquakes and vast areas of hot water are often tangibly apparent in that region, where those submerged caldrons of seething sulphur burn and glow for ever unquenchable.

The same chemical force and dynamic conditions which produced mountains in the primal days of earth are at work now, and in the course of time will bring about like changes of place and locations of seas and continents. As the volcanic plateaus in ocean become denuded and attenuated, they will continually be ruptured, and ridges will arise, and islands and mountains appear. Where water now covers earth, new-made continents will lift their faces to the light of sun and moon and stars. Our fertile valleys and low hill slopes, rich with fruits of trees, flowers, vines and cereals, will be deluged. The now submerged beds of seas will appear, and the deposits which those subterranean rivers have been gathering for countless ages will become fertile and inhabited continents. Earth is disappearing by denudation; hemispheres are contracting beneath the condensing processes which are eternally operating on this globe; altitudes, that place us above the deluge, are dwindling into the depths of ocean; mountains are being carried bodily into encroaching waters; the plains are perpetually being washed into the restless, surging tide; and continents are drifting to be submerged again beneath requiem-beating waves. This eternal change goes on and on for ever, yet, hardly with sufficient rapidity to satisfy the destructive and insatiate spirit of unrest, which makes mankind, ever hovering between hopes and fears, the strangest paradox which the human mind can study.

[NEW HAVEN JOURNAL AND COURIER.]

THE ENEMY OF THE OYSTER.

As the oyster culture is so important a business here, a few words about the oyster's most dreaded and deadly foe, "the star fish," will be appropriate; and we have gathered from authentic sources the following tolerably reliable information on the subject. The star fish destroys and devours the oyster eagerly. The star fish is well armed, having five of those useful members, and, to make matters worse for the oyster, has an eye on the end of each arm. It is also furnished with hundreds of small legs and feet. Its mouth is in the center of the body, and it moves slowly, but very "sure," when after prey. It can propel itself over rough surfaces and into all nooks and crevices, and is found generally near rocks, upon which they fasten. If one of its arms become broken in any way, as by getting it entangled in a crevice of a rock, or having it bitten off by a voracious fish, determined upon making havoc of this particular star, the deficiency is soon remedied, as another arm grows, which replaces the missing member. Some species of the star fish possesses the power of demoralizing or breaking itself in pieces and thus multiplying its kind, as each piece retains its vitality and grows into a perfect specimen of the tribe again. The star fish is a sociable animal. It generally travels in "schools," or mass-meetings, when, doubtless, schemes for raids on the unsuspecting oyster are devised, and nefarious information and ideas are interchanged. When he is hungry he gets outside of his dinner by, as it were, turning himself inside out, a novel process, not to be recommended to the *genus homo* as a mode of appeasing appetite. He turns his stomach out of his mouth and envelops the morsel to be engulfed. The star fish are set down by scientific men as a mere "walking stomach," being such tremendous gormandizers of sea food. They are particularly fond of oysters, and when the presence of a fine bivalve is discovered nothing can exceed it in lively appreciation of the morsel, not even an American at a clambake. In our harbor and immediately adjacent water our oyster culturists are not troubled with the star fish seriously, as yet, but in Norwalk and vicinity, it is said that they have become such a pest as to awaken no little concern and apprehension, and our oyster culturists watch with dread their appearance in plentiful numbers in our waters. Though traveling in schools single ones are often found, apparently meditative and morose, and bent on forming a new administration of affairs. It is said that a number of them often roll together and float with the tide, and when in this condition are often "half seas over." A school of star fish will settle down on an oyster bed, and then settle right down to business. They will completely destroy the bed in a short time. Each star fish will close upon its particular oyster, clasp it in his numerous arms and wait for it to open its mouth (a solemn warning to be close-mouthed), when the star fish turns his stomach inside out, over the oyster, and sucks out the entire living substance. In this way they will destroy acres of oysters in a very little while, a spectacle which the culturists behold with anything but cheerful emotions. Owing to their ravenous nature they are truly the bane of the oyster culturist. The star fish will cling to a rock so tenaciously as to lose its small legs (or feet) rather than loosen his hold, wherein he resembles some of the human species devoted to a particular idea. They also eat fish when they can get them, and do not refuse other animal matter, but their destructiveness principally settles upon the helpless and toothsome oysters. It will be seen that oyster culture is attended, like all other business, with hopes and disappointments, and is not a business that a sinecurist would devotedly covet. The utilizing of "mud bottom" for oyster culture is one of those interesting Yankee inventions. The blue mud is covered with a light layer of clean sand, and a crust thereby formed, upon which, just before the spawning season, dry oyster shells are spread to catch the oyster spawn, which, floating about, finds a lodgment upon them. If, however, by any unforeseen circumstance, the spawn does not "set," the whole labor is lost, and the shells have to be caught up and the ground cleared for the next season, as the spawn will not readily set on shells which have been in the water one season and thereby become slimy. We are told by an old oysterman in Fair Haven that this season bears the indications of being one of those seasons when there is no "set" in the harbor; if so, all those shells which have been spread recently in the harbor will have to be taken up again.

Another pest of the oysterman is "the drill," as they are called—a small animal which drills a hole through the shell of the oyster and sucks out the life. They are very difficult to find and almost impossible to exterminate; and after once getting into a bed of oysters the whole flat soon becomes worthless.

PREHISTORIC TREES.

THE following is an abstract of an interesting lecture delivered by Prof. Rolleston, M. D., F.R.S., at the meeting of the British Association. In the course of his remarks, referring to the various prehistoric trees, Dr. Rolleston said that the common elm in this country spreads entirely by suckers and not by seeds, while such trees as the spruce and larch spread with great quickness. The lecturer then pointed out an error into which Julius Cæsar had fallen in reference to the presence in Britain of certain trees which he had found in Gaul—particularly the coniferæ. The beech was probably a prehistoric tree, for beechmast was a very preservable thing. Buckwheat, or beechwheat, and beechmast, were one and the same thing in form, both being of triangular shape. The letters *f a g* lay at the bottom of the word for beech in most of the ancient languages in which it was named. The terms "bacon" and "beech" were allied, and a "bacon-fed" pig was a pig that had been fed upon beechmast. "Bacon" meant "beech," the article out of which bacon was made. After going over a list of the trees which chiefly arrest the attention as forming a portion of the landscape, the lecturer called attention to the fact that Chaucer, who was essentially a poet of nature, omitted from his detailed list of trees the names of the willow, beech, and birch. Spenser, writing later, and probably with Chaucer's description before him, had supplied the names of these three trees. It is the opinion of Professor Rolleston that the beech was present in England in prehistoric times, and that it formed a part of the landscape. Wych-elm was used, he thought, in very early times for the making of coffins, while birch had been put to the uses of tools. Remains of the ash were found in English peat, but they were not to be traced in the Scotch peat; nor were the remains of the beech to be found in Scotch peat. The spruce fir, or Norway pine, now of common importation, was not found in England at all, though it will flourish, and does flourish here, and spreads by seeds without help. The lime tree was, in England, taken great care of, and kept for the bees. There was, however, considerable doubt as to whether or not the lime tree was indigenous to England, though the lecturer had been informed that at a short distance from Worcester there was a large wood in which the small lime is found forming the entire mass of the underwood. Passing from trees to bees and their product, the Professor asked the question as to when the hive was introduced. The only real fact which they were able to get hold of in answer to this was that in all cases they found the word for hive always like the Latin term for that article. The taming of the bee had been ascribed, without any real reason for so doing, to several nations, but he would like his hearers to consider what must have been the difficulties of peoples having neither the sugar-cane nor the beet root from which to get sugar. These were compelled to get their sugar from milk or grain, or from similar sources, and honey must have counted for a very great deal.

PREHISTORIC FAUNA.

Passing on to prehistoric fauna, Professor Rolleston called attention to the great changes which have taken place in the mollusca of our country since those times. Referring to what had been termed the Roman snail, he said that this was, without doubt, a very old and well-established British snail. But there was a little snail which had come all the way from the Caspian, which was now found in such numbers in some parts of England that it would sometimes stop up water pipes, etc. It had been called a mussel, and looked something like one. Not long since it was reported that this snail had been found in prehistoric deposits, but this the lecturer could not believe. It came to us in large numbers from Russia with the timber which we got from that country, and which was floated down the rivers to put on board ship. It was easier for these creatures to establish themselves in and along the rivers of a country than in any other part of it. The rabbit had only very lately established itself in this country, for the lecturer had several times found flints, etc., at the mouths of burrows which had been thrown up by rabbits.

Now, had these rabbits been in the country for any very long time, the chances would be that the remains of all these barrows would have been destroyed. Consequently it was his opinion that the rabbit was not one of our prehistoric animals, but that it was probably brought over by the Romans as the chestnut, the sheep, and the fallow deer had been brought by them. The white-breasted marten, which had once been very prevalent, was a great enemy to the rabbit, and had, doubtless, kept the latter animal in check. In the Greek islands the rabbit was now very prevalent, but the Greek name for the rabbit he did not know, for, though the Greeks mentioned the hare again and again, they said nothing of the rabbit. The fallow deer must have lived in the times of Chaucer, who spoke of "the dreadful roe, the deer, the hart, the hind." The Norway rat, or gray rat, was not known in prehistoric times, nor was the black rat. The rat came to us from the other side of the Volga, but in one of the prehistoric tumuli the lecturer had found several handfulls of jawbones of the common water-rat. This at first puzzled him very much, but he subsequently found among the remains a large carnivorous tooth—a canine of the polecat, one of which animals had evidently made its nest in the tumuli and fed its young upon water-rats. Had not this one tooth been found he might have been led into an error.

BOILS, CARBUNCLES, ETC.

Dr. E. Bodman, of Sidney, Ill., sends us the following note: Years ago I was in the habit of treating boils, carbuncles, etc., with a strong solution of permanganate of potassa in the following manner: I laid the boil open to its bottom with a free incision and filled it with linen lint fully saturated with the solution. The results were quite satisfactory, but for some time past I have employed the following treatment which has been completely successful: I take equal parts of carbolic acid, glycerine, and water, and inject a few drops (5 to 30) with the hypodermic syringe into the tumor in its deepest part. One injection is usually enough, if applied in the early part of the disease. The tumor at once shrinks away with slight pain or soreness, leaving but little disposition to successive crops. If this mode of treatment has been in use by others, I have never heard of it.—*Boston Jour. of Chemistry.*

FAT IN ANIMALS.

Fat forms a larger percentage of the animal body than is generally supposed. Carefully conducted feeding experiments on cattle, sheep and pigs demonstrated that with the exception of the calf all the animals contained respectively more fat than lean, the fat ox and the fat lamb contained each three times as much fat as lean flesh, and the proportion of the fatty matters to the nitrogenous constituents of the carcass of the extra fat sheep was as four to one. In the pig the fat greatly preponderated over the lean, the store pig containing three times as much, and the fat pig five times as much fat as the lean. Since the above proportions are all based on the dressed carcass, and since the nitrogenous matters occur in greatest quantity in the offal, it will be found, taking live weights, that on the average a fat fully grown animal will contain forty-nine per cent. of water, thirty-three per cent. of dry flesh-forming matter, and three per cent. of mineral substance. In the lean animal the average proportion of the various constituents will be fifty-four per cent. of water, twenty-five and one-half per cent. of dry fat, seventeen per cent. of dry nitrogenous or flesh-forming substances, and three and one-half per cent. of mineral matter.

The fat of animals is identical in composition with the fatty or oily matter found in plants, and it is believed that the fat of the food is assimilated and forms the fat of the body. There appears to be this difference, however, between the fatty and starchy matter of food as producers of animal fat, that an animal can produce its own fat from the fatty matter of its food more readily than from compounds not fatty in their nature, such as starch and sugar. A pound of fatty matter is supposed to be equal to two and a half pounds of starchy matter, or two and three quarter pounds of sugar, for fattening purposes. The value of the fat is also augmented by the fact that it requires less chemical change in the animal to adapt it to its immediate use than in the case of starch or sugar. The more fatty matter, therefore, any kind of food contains, the better it is adapted for the fattening of stock, since, although starch is convertible into fat, during its conversion a large proportion of its constituent items is converted into water and carbonic-acid gas, and passes off in perspiration and breathing.

In the fattening animal the increase proceeds in the muscular system or flesh, and especially in the fatty tissues associated with it. The formation of fat continues in the animal frame under all ordinary circumstances, since more or less fat is always found in even the leanest animals; hence fat must be regarded as an essential constituent of the body. When abundantly fed, the accumulation of fat in the tissues seems to be capable of increase almost to an unlimited extent, if the mammoth size and obese condition of some of the premium animals at the cattle shows are taken as a criterion. The best condition for the formation and accumulation of fat consists in the vigorous assimilation of the fatty, oily, starchy principles of food, with a degree of warmth and an absence of exercise that shall make the least demand upon the body of the animal.

Respecting the fatty constituents alone, linseed or flax seed takes the lead, containing 34 per cent. of oil, while cotton seed, hulled, contains 31.24 per cent. Since these oils are so valuable for other purposes than feeding, the seed is pressed in mills, the oils extracted, and a solid residue or cake is obtained, which in the case of linseed cake contains about 10 per cent. of oil, while the cotton seed cake contains 12 per cent. and rape cake 11 per cent. of oil. Indian corn contains over 8 per cent. of ready-formed fat, or more than is found in most of the other grains, hence it is exceedingly well adapted for feeding purposes; the average percentage of fatty matter in the hay of artificial grasses is 3.18; wheat straw just ripe, 1.74; barley straw not too ripe, 1.17; oat straw cut green, 1.57; bean straw, 1.02; pea haulm, 2.34; flax chaff, 2.82; while the turnip shows but 0.26 per cent. of oil; the white beet, 1.5; the artichoke, 0.4 and the potato, 0.2; parsnip, 0.5. Of grains other than corn, oats contain 5.6 per cent. of fatty matter; rye, 2.25; wheat, 2.12; barley, 2.76 and rice 0.8 per cent.

The starchy saccharine and gummy substances are composed of the same elements as the fatty bodies, but in different shape. As fat forms so large a portion of the body, the part it plays in the animal economy must be a very important one. Fat is the source of internal heat, and in the animal organism it is burned; the process of combustion is a slow one, but still the total amount of heat evolved is just the same as if the fat were consumed in a furnace, and thereby animal heat and warmth is maintained. Hence the importance and necessity of warm shelter during the inclement season of the year, that the fatty deposits may remain to increase the weight of the animal, rather than be wasted in keeping up the requisite animal heat.—*Boston Cultivator.*

RUDOLF L. C. VIRCHOW.

Virchow's career has been a remarkable one—in some respects it has been extraordinary. A profound and original thinker, a scientist of acknowledged ability, the founder of a new school in pathology, a distinguished and eloquent teacher, a prolific and brilliant writer, he has proved himself an able statesman, a skillful political organizer and a leader possessing both energy and tact. He is equally remarkable for his æsthetic culture, and his acquirements in archæology or in music would make the reputation of many an inferior man. To write even a sketch of his life would be to review the history of German politics, as well as to analyze the

RUDOLF L. C. VIRCHOW

various changes that have taken place in the condition of medicine, during more than a quarter of a century, and that the most unsettled, the most changing period, because it has been the most progressive and the most fruitful in results. His life has been one of unusual activity, of extraordinary excitement. He seems to have had two separate existences, the one, generally, considered incompatible with the other—the turmoil and excitement of politics, and the quiet and retirement of scientific pursuits. But even his scientific career has not been a quiet one: it has been essentially aggressive, for the construction of new theories involved the destruction of old and cherished notions that had taken deep root in the public mind. He says himself, in his introduction to the seventieth volume of his Archives: "What anxiety it has cost to uproot the doctrines of the humoral pathology, buried amidst the ruins of thousands of volumes, and to erect in its place a system based on a knowledge of the tissues, one that would form the true basis of pathology and therapeutics!" He has waged an incessant warfare to break down false theories, to uproot false principles; he has labored to place the foundations of pathological science on a basis at once broad and deep, and so firmly and solidly bound together that they will resist all attempts to uproot them in the future His proposition has been that: "Pathology must be a self-existing science."

Virchow was born, October 13th, 1821, at Schivelbein, in Pomerania. Our portrait and these particulars are from the *Sanitarian.* He graduated in 1843, receiving the degree of Doctor of Medicine and Surgery.

He soon became assistant physician, and later prosector in the Charity Hospital, and subsequently *privat-docent* in the University of Berlin. Here he found every facility for pursuing the study of his favorite science, and, in company with his friend Reinhardt, devoted himself to the study of *pathology* and *pathological anatomy.* The fruits of these studies were first given to the public in the "Archiv für Pathol. Anatomie und Physiologie," which he, with Reinhardt, founded in 1847. This journal he has edited and published without assistance since the death of his associate, in 1852, and he has made it one of the most valuable medical periodicals published in the German language.

Virchow is the founder of the so-called school of *Cellular Pathology.* This system was fully set forth in his great work, "Lectures on Cellular Pathology" (Vorlesungen über Cellularpathologie in ihrer Begrundung auf physiol. und pathol. Gewerbelehre), published in 1859, in Berlin. This work has been translated into nearly every European language, and in 1862 reached a third edition.

Virchow's contributions to sanitary science have been numerous and valuable. He says, however, that very many doctors take no interest whatever in *sanitary* subjects, and that some look on them even with disfavor.

THE POISON OAK OF CALIFORNIA.

By James G. Steele, Chemist.

Being a subscriber and constant reader of the Scientific American, I have noticed in several of the recent numbers articles concerning "*Poison Ivy,*" and "*Poison Oak,*" together with various remedies used to neutralize the pernicious effect (to many) of unwary contact with these poisonous plants. Business cares have prevented me from contributing sooner what I hope may prove interesting to your readers concerning the "Poison Oak" of California, and likewise a plant of indigenous growth used extensively with us to counteract the distressing inflammation caused by our species of "rhus toxicodendron."

In the woods and thickets of California, as well as on the dry hillsides, in fact in every variety of locality, may be found a very venomous shrub, the "Poison Oak" or "Poison Ivy," the "*hiedra*" of the Spanish and native California people, the dread of all who are acquainted with it. This plant is known to botanists as "rhus diversiloba" or "rhus toxicodendron," and resembles the poison ivy of the Atlantic States both in appearance and poisonous qualities. It has a somewhat climbing stem, with short, leafy branches, and is easily recognized from the fact of the discoloration of many of its leaflets, caused by the oxidation of the green coloring-matter of the plant, giving it an unmistakable scorched or blasted appearance.

Poison Oak is the cause of a vast deal of misery and suffering in California. There is scarcely ever a time, in any little town or neighborhood, when there are not one or more persons suffering from it, and it has been estimated that there are in this State near three thousand persons constantly afflicted with the cutaneous disease caused by this dreaded scourge. Not only tourists and occasionally visitors into the rural districts from our cities, but even farmers and laborers are liable to this poisoning, and besides the suffering and annoyance caused by it, the loss of valuable time is no small item to be taken into account. As has been often remarked, it would seem that whoever makes known a prompt and sure antidote to this poison would be considered a public benefactor.

Many and various have been the "remedies" with which our local practitioners have endeavored to combat the effects of the universally dreaded Poison Oak. When I mention a few, such as lotions and ointments of lead, bismuth and opium compounds, applications of hartshorn and various alkaline salts in every variety of combination, it will be seen that not only is this scourge of wide prevalence, but of deep practical interest to the physician and pharmacist, for every medical practitioner meets with more or less cases of it in his daily rounds.

The many remedies which have been used for counteracting the effects of Poison Oak all give way in efficiency and celerity to the "*Grindelia robusta.*" This, like the "*rhus toxicodendron,*" is indigenous to the State and found in many parts, but grows most luxuriantly in the foot-hills of the Sierra Nevada and Coast Ranges of mountains.

Grindelia robusta is a tall, stout perennial, belongs to the Composite family, and looks like a small sunflower. It is from one to three feet in height, and has bright yellow flowers in heads, one or two inches in diameter, flowering from June to October. Before flowering the unexpanded heads or petals secrete a quantity of resinous matter, white and sticky, like balsam, that is finally, after the flower expands, distributed like varnish over the petals of the flower. The whole plant, at this season, flowers and leaves, is resinous and viscid. When it grows in dry hills it is stiff and rigid with narrow thin leaves; but in damp localities it is more robust and succulent with wide fleshy leaves. May and June are the months in which the Grindelia should be gathered for use, as at that time the plant abounds most in the balsamic and resinous juice in which its medicinal properties reside, and causes its marvellous effect in the cure of the eruption from oak poisoning, for which purpose it has been used with good effect since the occupation of the country by the Americans.

Dr. C. A. Canfield (deceased), of Monterey, Cal., was the first to call the attention of the medical profession to the therapeutic action of *Grindelia robusta* in cases of "Poison Oak." Some twelve years since he caused to be published, in the *Pacific Medical and Surgical Journal,* a short account of this plant, its botanical features, habitat and medicinal value. My attention being thus directed to the plant, I procured specimens, and prepared various pharmaceutical compounds containing the virtues of the drug, which were prescribed by the medical faculty of this city, with sufficient success to warrant me in keeping a bountiful supply of the plant. It has been my practice yearly, during the months of May and June, to go into the rural districts and have gathered and dried in the shade 1 or 2 tons of *Grindelia robusta.*

I have experimented in different ways to obtain a "Fluid Extract" which should fully represent the medicinal virtues of the leaves and flowering tops of the plant. The fluid extract, which is the most concentrated form of preparation used, contains in one pint the strength of sixteen troy ounces of the drug and is made by the following process: A sufficient quantity of the carefully picked leaves and tops of the Grindelia are put into a suitable vessel and nearly covered with a mixture of one part of water to two of alcohol, allowed to macerate for twenty-four hours, a strong cover being laid over and pressed down with appropriate weights. At the expiration of this time the whole is transferred to a percolator with a stop cock attached; and after remaining for five or six hours, the resulting liquid is drawn off and the residue in the percolator taken, transferred to strong bags, and submitted to the action of a powerful press. The liquid from this is now mixed with that from the percolator and set aside. It is generally requisite to repeat the process with one half the amount of menstruum, and the results being mixed together should measure one pint for every sixteen troy ounces of the drug employed. In case, however, the full measure is not obtained, enough alcohol is added to supply the deficiency, and the whole rapidly filtered and transferred to well-stoppered bottles. This process gives a clear, thin, nice-looking fluid extract, with a pleasant odor and characteristic aromatic taste, and which can be kept a long time with usual precautions without any deposit. It may be presumed that the medicinal virtues of the *Grindelia robusta* reside in the viscid and resinous juice before mentioned. Confirmatory evidence offers itself in the fact that the plants gathered from the lower and marshy grounds are more robust and succulent, the leaves and stalks larger and coarser in appearance and devoid almost entirely of the "balsam" before mentioned, and has little efficacy in the eruption of Poison Oak. The directions are as follows:

For Poison Oak eruption, the best method is to mix one or two teaspoonfuls of the strong fluid extract of Grindelia with half a tumbler of cold or tepid water, and apply freely with a sponge or cloths dipped in the mixture to the parts affected. One or two applications will often suffice for a cure, but if the disease has been of long duration, several days may elapse before entire relief is obtained. In severe cases of poisoning, cloths dipped in the solution may be bound upon the parts and, if necessary, more of the fluid extract added. The most obstinate case of poisoning will be overcome by this mode of treatment, and immediately after the first application the most surprising relief is experienced. Another medicinal use has been found for *Grindelia* and its preparations. *Asthma* and kindred ailments have been made to succumb in a remarkable manner. For fear of tiring the patience of your readers and with a due regard to the value of space, I will forbear further mention of this, save to remark that in case it may prove of interest to excite inquiry, something could be written of our experience of the value of the drug in this connection.

The *Grindelia robusta* and its various medicinal preparations can be found in well-appointed pharmacies in the large Eastern cities; and in case none is to be found at hand, application to the writer will result in discovering a way to procure it in any desired quantity.

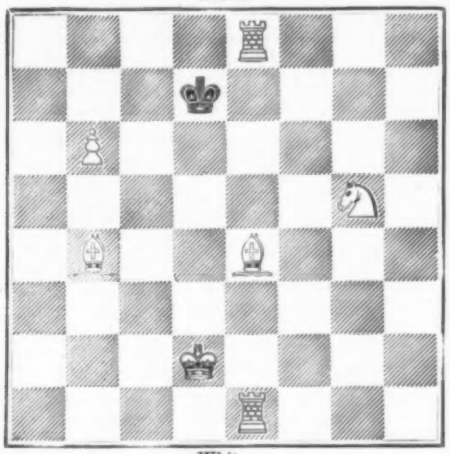
San Francisco, Sept., 1877.

SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 21. BY N. MARACHE.

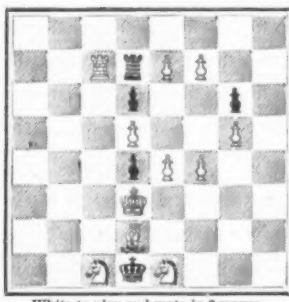
Black.



White.

White to play and mate in two moves.

NAPOLEON MARACHE.



White to play and mate in 3 moves. JOHN WILKINSON.

PERHAPS no better illustration of the truth of my remarks in a recent letter to the *Chess Journal*, to the effect that "the works of a problemist will last for centuries, while the reputation of a player departs with him," could be found than in the subject of our present sketch. For a long time Mr. Marache was considered the strongest American chess player, and even as late as 1856, he won the silver cup, and championship of the New York Chess Club, and also defeated Chas. H. Stanley, the recognized chess champion, who was also a skillful problemist. It was then decided, in case Mr. Morphy did not put in an appearance at the American Chess Congress which was then being arranged, that Mr. Marache should be sent to New Orleans to play him a match for one thousand dollars. And, yet, although he died only so recently as May, 1875, we find his fame as a player entirely ignored, and there are positively scores and scores of second and third rate players who claim to have been his superior, now that he is no longer here to defend his fame. True, of late years he had quite abandoned chess play, was out of practice, and lost his force; nevertheless, it is a fact that such is the termination of the brilliant career of any chess player, but we to whom his memory is dear can only be thankful that his chess genius took a higher flight than the mere playing of games, and has left a wreath of problematical gems that will retain their brilliancy when our famous players have been forgotten.

Mr. Marache was a prolific and versatile composer of neat and pretty problems; difficult or elaborate positions were not his forte, and for this reason his compositions were favorites with the public, and were greatly admired on account of their grace and neatness. He composed in all about seventy-five problems, which will be found in the "American Chess Nuts," two of which we select as fair specimens of his skill.

Mr. Marache was born in the year 1818, at Meaux, in France, came to this country at the age of thirteen, learned chess in 1844, commenced the construction of problems the following year, and by this practice became a skillful player; in 1846 he published the *Palladium*, the first American chess magazine, and afterwards successively edited the chess departments in the *Clipper*, *Frank Leslie's*, *Porter's Spirit*, and *Wilkes' Spirit of the Times;* in 1865 he wrote "Marache's Manual of Chess," a popular little work, which is unsurpassed as a treatise upon the rudiments of the game.

Like most of our chess players, he was a skilled musician, although he abandoned the art as a profession and held a position of trust in the New York Union Bank, where he was loved and respected by all, being an accomplished and perfect gentleman, without an enemy in the world.

JOHN WILKINSON'S PROBLEM BOOK.

THE initial problem for this week is selected from a neat little collection of one hundred and sixteen problems published by John Wilkinson, of Chicago, an old friend whom we knew in our younger days as a skillful player, but whom we had never suspected of being such a prolific composer of problems. He seems to have depended entirely on his memory for positions as well as solutions, having abandoned chess for so long a time that he is no longer able to solve his own problems, the result being that we have never seen so many faulty positions brought together before; but even this becomes almost a merit from the pleasant way in which he admits his faults. In a little appendix he says: "It's bad, very bad, to find a stupid blunder in the very first problem. There should be a black pawn at black queen's seventh square (which does not mend matters.—ED.) If the composer had not been the compositor he would lay the blame on the printer. As it is, the error must be charged to the proof reader, who wears the author's hat.

"And, again, if any evil-minded person should discover a second solution to one variation of Problem XLII, let him be charitably disposed, and bury the secret in his own bosom."

PROBLEMS FROM THE PAGES OF HISTORY.

IN the 53d chapter of Don Quixote, the Barber says: "Por mi, doy la palabra para delante de Dios de no decir laque veuftra merced dixere a Rey no a Roque." Literally, "As for me, I give my word before God, not to tell what your worship shall tell me, to King nor to Rook," which latter clause is a Spanish phrase meaning nobody. Shelton, the first English translator, in 1652, has rendered it, "neither to King nor Kaiser" (emperor). Motteux, Ozell and Kelly have enlarged upon the passage, and say: "Neither to King, Queen, Rook, Knight or Pawn," and, in a note, mention that the allusion is to the game of Chess, then so common in Spain. Smollett says: "Either to King or to Knave."

The French translators say: "a Roi ni a Roc." The Dutch have rendered it· "I shall tell it to neither Cat nor King." Wilmot, Bralle, and most other translators, have rendered it Rook. Yet none, not even Cervantes himself, quoted the proverb correctly, which should be rendered: "Before God and your worship, I'll tell neither King, Knight or Rooks."

I ascribe its origin to Sacchetti's pleasant novel of the Curate of Valdipea, who, as everybody remembers, often played at chess with a gentleman of his neighborhood, whom he used to checkmate five times out of six; notwithstanding which the gentleman would not only not allow it, but often boasted of his score with the curate. One day it happened that the curate checkmated him in the middle of the chess board, *with nothing but a Knight and two Rooks*. This the gentleman, ashamed and displeased, would not allow, which the curate perceiving, ran to the bells, which he began to ring. The peasants, hearing the alarum, ran towards him in crowds, and wanted to know what was the matter. Said the curate to them: "I want you to see and bear witness that I have given him checkmate in the middle of the board with a Knight and two Rooks!" The clowns began to laugh, saying: "Master curate, you make us lose our time," and went away. This the curate repeated so often that the peasants at last paid no attention to the ringing of the alarum bell. At length the curate's house took fire, and the peasants, hearing the bell, said to one another: "The curate is again playing chess; let him ring; he had better mind his prayers." And so the house burned down. The next day the peasants apologized, saying: "We thought you were playing at chess;" to which the curate answered: "I was playing at chess with the fire, which has given me checkmate and ruined me."

NAPOLEON MARACHE.

From this incident, doubtless, arose the common proverb: "Non e tempo da giuocar a scacchi quando la casa brussia:" or, in English. "It is a time to leave off chess when a man's house is on fire.'"

Our better half often quotes the proverb "Three moves as bad as a fire," but we always supposed this referred to the moving of other pieces besides chess.

The former proverb must have had its origin from the exclamation of the defeated friend of the curate: "Explain the secret of mating in the middle of the board with only a Knight and two Rooks, *and as for me, I give my word before God not to tell what your worship shall show me, not even to King, Knight or Rooks.*"

It is strange that this anecdote, with a curious problem involved, should have been criticized in all languages, and yet stood the test of centuries before any one thought of the simple and common-sense plan of utilizing the chess board, and mating the king in the middle of the board with a knight and two rooks.

[The attention of our readers is especially called to this problem, as its solution (to be given in due time) is a complete and satisfactory explanation to a much disputed question of history.]

REVOLUTIONARY CHESS ANECDOTE.

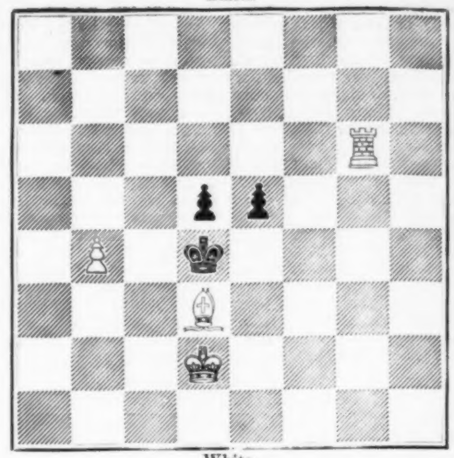
AT a meeting of the New Jersey Historical Society, at Newark, N. J., ex-Gov. Price, in response to a toast, made a speech, in which he related the following anecdote:

On the day preceding the night on which Gen. Washington had determined to cross the Delaware and attack the British in Trenton, an Englishman in the neighborhood dispatched his son with a note to Gen. Rahl, to warn him of the approaching danger. The General being deeply absorbed in a game of chess when the note was presented, without withdrawing his attention from the game, he thoughtlessly put the note into his vest pocket. After the battle next day, when Gen. Rahl was brought in mortally wounded, the note was found unread in his pocket.

Samuel Warren. in his "Introduction to the Study of Law," maintains that chess is excellently calculated to chain a wandering mind to its task—to induce those habits of patient and vigilant attention, cautious circumspection, accurate calculation, and forecasting of consequences which are essential to the successful study and practice of the law."

PROBLEM No. 22. BY N. MARACHE.

Black.



White.

White to play and mate in five moves.

SOLUTIONS TO PROBLEMS.

No. 17.—BY S. LOYD.

WHITE.	BLACK.
1. Q *stoops* to Kt sq	1. B or P moves (best)
2. B to B 2	2. Any move
3. B x P	3. Kt x B
4. Q to B 5 mate	

No. 18.—BY E.S. BREWSTER.

WHITE.	BLACK.
1. K to Q 7	1. K to K 4
3. R to B 4 ch	2. K to B 4
2. K to K 7	3. Any move
4. B to K B 6	4. "
5. R to K R 4	5. K to Kt 3 or B 4
6. B to K 4 mate	
	1. P to B 4
2. K to Q 4	2. P to B 5
3. B to K 2	3. K to K 5
4. R to K B 3	4. P to B 6
5. B to Q B sq	5. Moves
6. R to B 4 mate	

LETTER "O."—BY L. QUIEN.

WHITE.	BLACK.
1. Q to K Kt sq	1. Any move
2. Mates	

POSITION ON STAUNTON'S BOARD.

WHITE.	BLACK.
1. Kt to B 6	1. K to R sq
2. K to B 2	2. K x Kt
3. Kt to Kt 4 ch	3. K to R sq
4. K to B sq	4. P to R 7
5. Kt to B 2 mate	

STANLEY AND ROUSSEAU.

ONE of the most important matches recorded in the annals of American Chess was played at New Orleans, in the year 1845, between Mr. Charles H. Stanley, the eminent player and problemist of New York, and Mr. Eugene Rousseau, of New Orleans, for a stake of one thousand dollars, the result being Stanley, 15; Rousseau, 8; drawn, 8. These players are both living, well advanced in years, but still cherishing their love for chess. Mr. Rousseau took part in the Paris Tournament of '68, and is of French descent. Mr. Stanley hails from England, but has resided for upwards of thirty years in New York. We have played many games with both, and consider them of very equal force.

STANLEY. WHITE.	ROUSSEAU. BLACK.
1. P to K 4	1. P to K 4
2. K B to Q B 4	2. Kt to K B 3
3. Kt to Q B 3	3. B to Q B 4
4. Kt to K B 3	4. P to Q 3
5. P to K R 3	5. Castles.
6. P to Q 3	6. B to K 3
7. K B to Kt 3	7. Q Kt to B 3
8. Q Kt to K 2	8. Q to K 2
9. Q Kt to K Kt 3	9. Q Kt to Q 5
10. K Kt x Q Kt	10. K B x Kt
11. P to Q B 3	11. K B to Kt 3
12. Castles.	12. P to Q 4
13. Q B to K Kt 5	13. P to Q B 3
14. Kt to R 5	14. P x P
15. P x P	15. Q B x K B
16. Q to K B 3	16. Q B to B 5
17. Q B x Kt	17. Q to K 3
18. Kt x Kt P	18. Q B to K 7
19. Kt x Q	19. B x Q
20. Kt x R, and Mr. Rousseau resigns.	

WILLIAM, the Conqueror, in his younger days, while playing at chess with the princes of France, was unexpectedly mated, which so provoked him that he threw the chess-board at his adversary's head. This contest seems to have been carried on between their sons in much the same spirit; for we read that, towards the close of William's reign (1087), his son Henry played chess with the Dauphin (Louis de Gros) and won a large sum of money from him, which so enraged Louis that he threw the chess board at Henry's head; or, as the wag of the court is reported to have said, "although Louis was at first unsuccessful, *he soon turned the tables against his opponent.*"

JOHN of Salisbury relates that, in a battle between the French and English, in 1117, an English knight severed the bridle of Louis le Gros, and cried out, "The king is taken!" Louis struck him to the ground with his sword, saying, "Dost thou not know that at chess the king is never taken?"